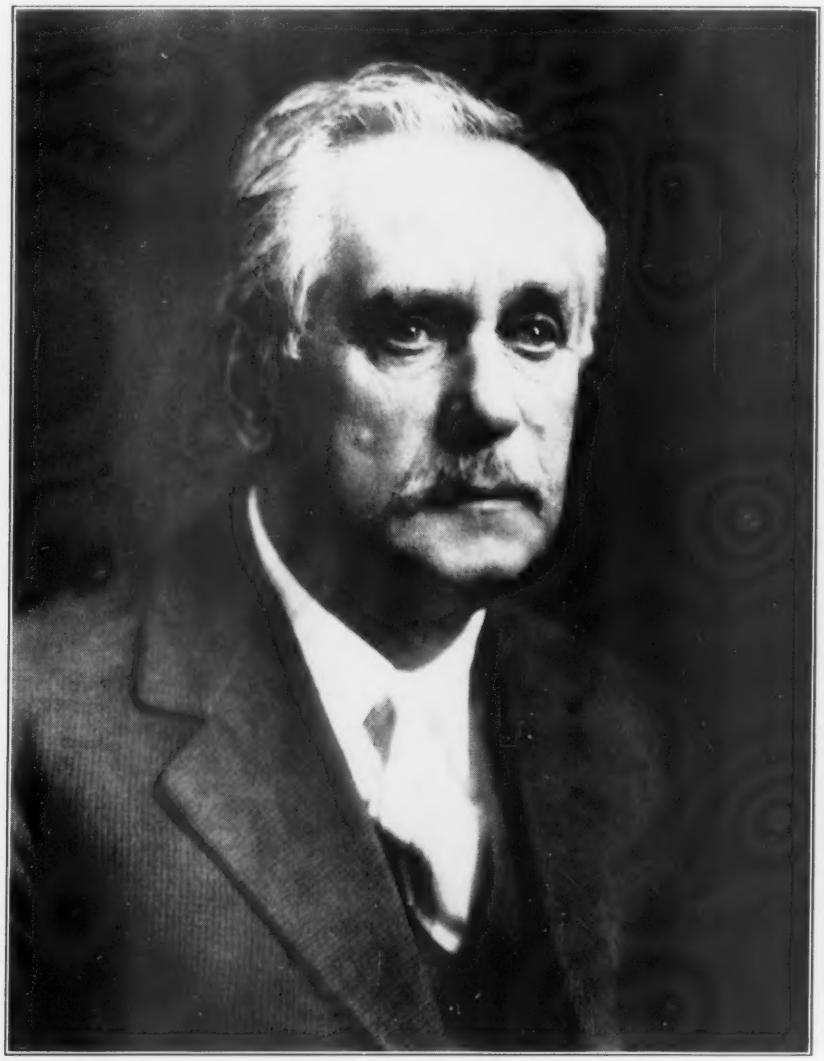
THE BULLETIN

OF THE

AMERICAN CERAMIC SOCIETY

Volume 18 DECEMBER, 1939 Number 12



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Publication Office: 20th & Northampton Sts., Easton, Pa.
Editorial and Advertising Office: 2525 N. High St., Columbus, Ohio.
Executive Office: 2525 N. High St., Columbus, Ohio.
Committee on Publications: J. D. SULLIVAN, *Chairman;* E. E. MARBAKER, A. N. FINN, W. W. WINSHIP, ROSS C. PURDY.

Entered as second-class matter at the post office at Easton, Pa., under the act of March 3, 1879. Published monthly.
Subscription $1.50 a year. Single numbers twenty-five cents.
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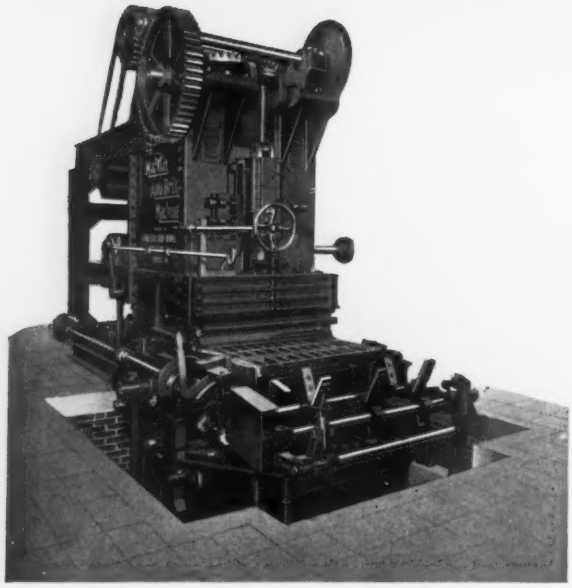

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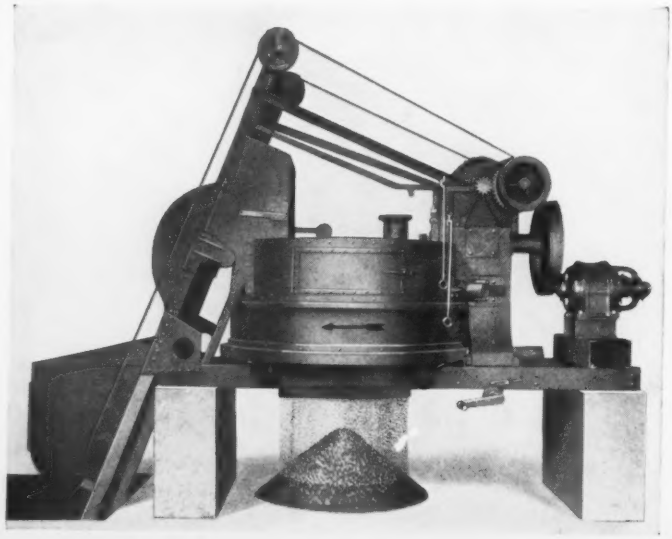

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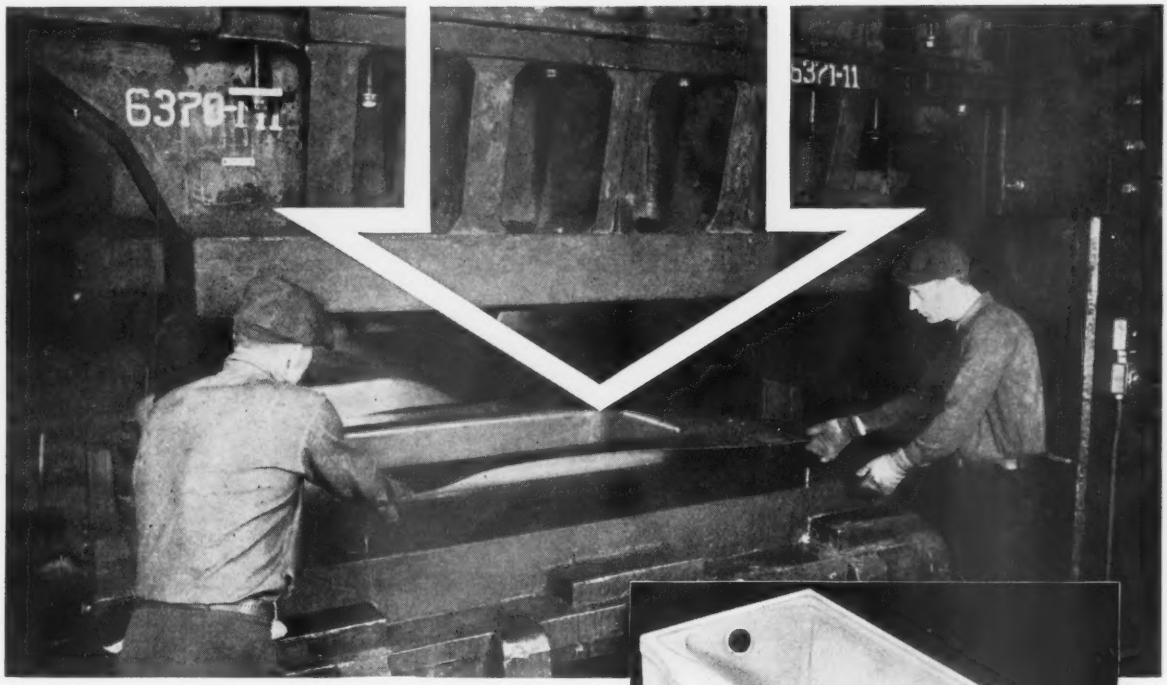

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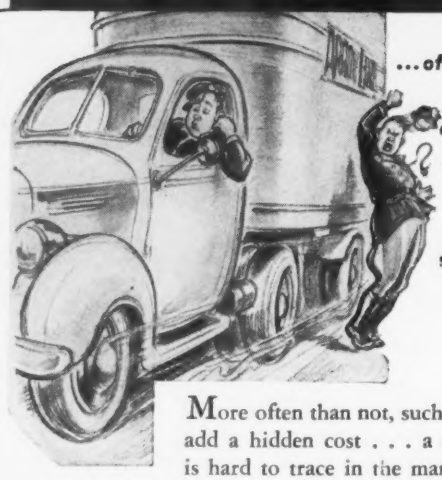

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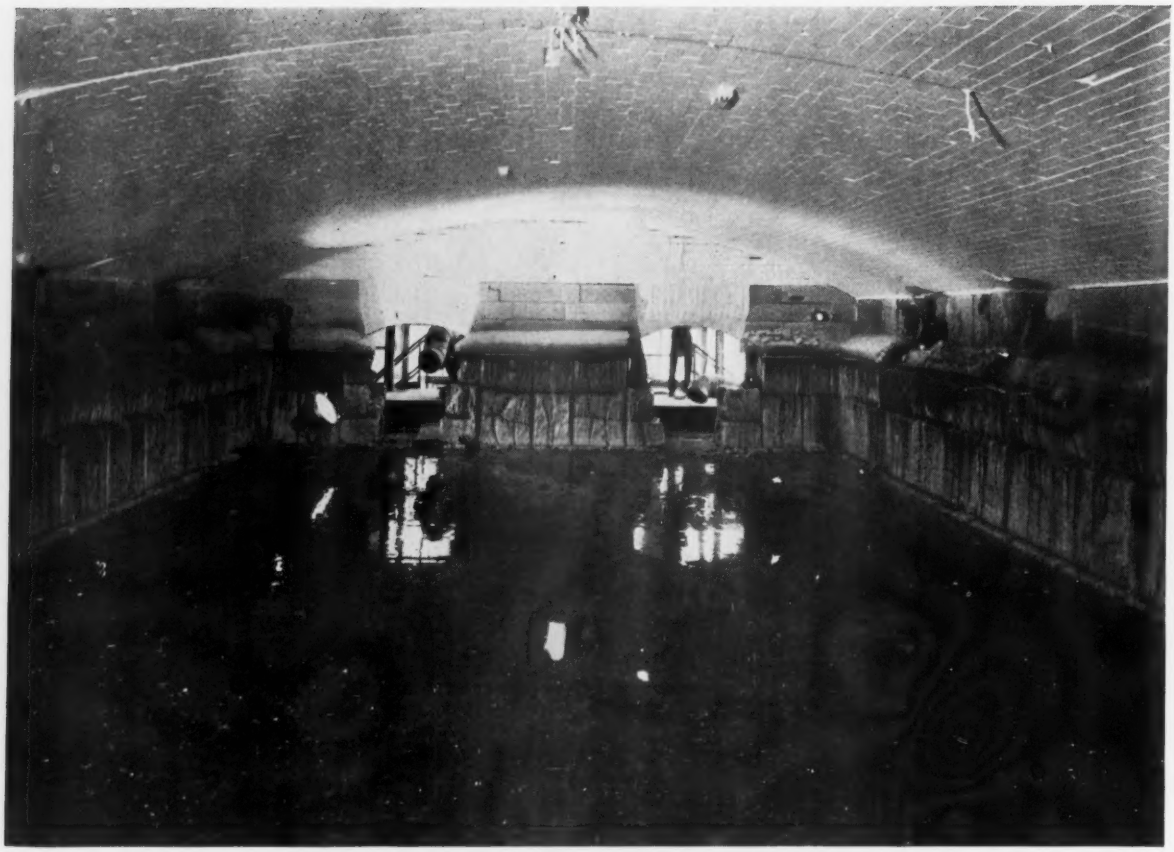

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Volume 18 DECEMBER, 1939 Number 12

PAPERS

MAT GLAZES AND THE LIME–ALUMINA–SILICA SYSTEM*

By Hewitt Wilson

Abstract

The following study is an attempt to show the correlation between normative calculation, recent petrographic examinations of mat glazes, and the corrected Rankin and Wright $CaO–Al_2O_3–SiO_2$ system with respect to (1) $Al_2O_3–SiO_2$ surfaces from cones 28 to 42; (2) $Al_2O_3–SiO_2–CaO$ glazes, cones 13 to 15; (3) $Al_2O_3–SiO_2–CaO$–feldspar glazes, cones 6 to 15; (4) $Al_2O_3–SiO_2–CaO$–feldspar–ZnO glazes, cones 5 to 10; (5) $Al_2O_3–SiO_2–CaO–PbO$ glazes, cones 02 to 3; and (6) $Al_2O_3–SiO_2–CaO–PbO$–feldspar glazes, cones 02 to 3.

I. Introduction

In the first article on mat glazes published in the *Transactions of The American Ceramic Society*, Binns[1] presented several basic ideas on the cause of matness, viz., (1) true mats are not scum effects and are not due to immaturity; (2) a good mat texture can be produced by raising the alumina, the exact amount depending on the other constituents; (3) it is easier to make a mat with a basic glaze than with high silica glazes; and (4) (discussion), matness is not produced by coarse crystallization but rather by fine crystallization with crystal interference.

Purdy[2] brought out the importance of lime and the relation between lime and the alumina derived from the clay content. He introduced the norms, anorthite, wollastonite, leucite, and orthoclase, and emphasized the importance of calculated anorthite and wollastonite in mat development.

Pence[3] showed the importance of a slow rate of cooling to develop the microcrystalline structure and compared the development to chemical precipitation of saturated salts in aqueous solutions.

(1) Recrystallization

The mat glazes of the studies made by the author are believed to be of the microcrystalline type, containing undissolved matter, it is true, but primarily with such a large amount of fine microscopic crystallites that the large reflecting surfaces of glass are missing. Mat glazes are never transparent; at the best they are translucent. The crystallization in most cases is uniform throughout the thickness of the glaze except in close contact with a siliceous body which has added silica to the more basic glaze. The composition of the crystalline phase varies with the composition of the glaze, but it is found in the simplest alumina-silica mixtures as well as in the basic and complex.

Certain difficulties arise in the use of theoretical equilibrium data for the production of commercial mat glazes. The course and amount of crystallization shown by the theoretical systems are modified by (1) the comparatively coarse grinding of the batch glaze compositions, (2) the comparatively short time for melting and complete interaction of the ingredients, especially the solution of quartz by the basic oxides, (3) the interaction of the glaze with the body to cause changes in composition at the interface, and (4) the rapid time of cooling which permits only those compounds having the fastest rate of crystallization to develop.

Mullite crystals form with great rapidity; it is difficult in fact to get large amounts of glass from a quenched mullite liquid which has been melted in the electric furnace. Crystals of mullite likewise grow rapidly from basic solutions at low temperatures.

---

* Presented at the Golden Gate General Meeting, American Ceramic Society, San Francisco, Calif., August 8, 1939. Received September 29, 1939.

Contribution from the Department of Ceramic Engineering, University of Washington, Seattle, Wash.

[1] C. F. Binns, "Development of the Mat Glaze," *Trans. Amer. Ceram. Soc.*, **5**, 50–63 (1903).

[2] R. C. Purdy, "Mat Glazes," *ibid.*, **14**, 671–81 (1912).

[3] F. K. Pence, "Theory for Cause of Matness in Glazes," *ibid.*, **14**, 682–90 (1912).

Less is known about the rapidity of anorthite and wollastonite crystallization, but because both are common in various slags, it has been assumed that they are sources of the crystalline structure of mat glazes. Quartz, tridymite, and cristobalite, on the other hand, are slow to crystallize, although they have been identified in small quantities in mat glazes, and in one case[4] they were reported to be the cause of a mat texture.

The present review is likewise handicapped by the lack of experimental data, not only of theoretical studies in the range of composition, but also because of the lack of petrographic examination of the mat glazes that have been produced. Many of the studies were made before accurate petrographic methods were in common use, and the type of crystalline structure is one which does not lend itself to easy identification. Although it is believed that most mat glazes owe this type of texture to crystallization, the crystals are microcrystalline in contrast to the "crystalline" glazes whose crystals are apparent to the naked eye. Thompson[8] and Parmelee and Horak[4] are among the few investigators who have made qualitative identification of the microcrystallites, but accurate quantitative data are missing. Even the relative quantities of glass versus crystalline material has not been determined by experiment. Solution of the basic glass films and separation from the crystalline mass by hydrofluoric acid or weaker acids and the analysis of the solution would aid in the identification of the crystalline residue.

Vain attempts have been made by the author to identify mat and gloss glazes by the calculation of the relative percentage weights of glossy norms or those compounds which crystallize with difficulty, such as the silica minerals, lead silicate, feldspar, etc., and the mat norms, including mullite, anorthite, and wollastonite. The overlapping is too great, and distinct identification is noted only in the extreme cases. This probably is due to the variable rates of crystallization of the four compounds in different combinations and under different conditions.

(2) Immaturity

Immaturity, or the presence of undissolved matter, has been given many times as the cause of matness. The microscope has shown that many glazes, both mat and gloss, contain fairly large quantities of undissolved matter, especially quartz. Usually this does not affect the texture of the gloss glaze because the undissolved portions are isolated, coated, and separated by thick layers of glass. It is significant that a gradual overloading of a gloss glaze with certain compounds produces matness, but with others a dulling and roughening of the surface is produced which cannot be called matness. An increase of silica, tin oxide, zinc oxide, or certain refractory coloring oxides, such as titanium oxide, will roughen the surface as soon as the solution capacity of the glass is reached. If the temperature is then raised, the texture again is gloss. But the addition of alumina, clay, or lime will give the soft, silky surface over some temperature interval and composition range before showing the rough surface. Few studies give any indication of amounts of crystalline material needed to hide the glassy surface.

(3) Rate of Cooling

Another variable is the rapidity of cooling. In the correlation of a miscellaneous series of studies whose tests have been fired in all types of kilns from the small laboratory to the large 100-hour commercial kiln, it cannot be expected that all results will agree.

(4) Nomenclature

Another correlation difficulty is based on the fact that the glazes called "mat," "satin," or "gloss" or combinations of these were identified by different persons whose ideas of matness do not agree. A "mat" glaze in one terra cotta company will be called a "satin" in another. Other glaze compositions lie on the border line; 3- by 5-inch samples fired in commercial terra-cotta kilns have had gloss at one end and mat at the other.

II. Al_2O_3–SiO_2 System, Cones 28 to 42

A petrographic study of a series of fused Orton cones was made by Roy D. McLellan at the University of Washington in 1923. Cone 28 (approximately $Al_2O_3 \cdot 10SiO_2$) according to Ries (but containing feldspar according to Fairchild and Peters) was found to be a white melt with a smooth glossy surface. The greater part of the melt was composed of glass. From numerous points within the glassy matrix, minute crystals of mullite (called artificial sillimanite in 1923) were just beginning to form. The points of crystallization were so numerous that they gave a cloudy appearance to the thin section. Cones 29 and 30 were similar to cone 28, with the amount of crystalline material increasing with each increase of alumina. Cone 31 had a glossy surface, but the depth of gloss was missing. The thin section showed the various centers of crystallization to be united by an intergrowth of the long needlelike crystals. The ground mass was still glassy and some places remained free of mullite crystals.

Cone 32 had a soft mat glaze surface. The field of the thin section was completely filled with needlelike mullite crystals whose diameters were too small to yield an interference color between crossed Nicols. Aggregate polarization was beginning to appear. The spaces between the crystals were filled with glass. Cone 33 had a dull mat surface. Mullite had developed into rodlike crystals of sufficient diameter to yield an interference color, and glass was still present in abundance in the matrix. Cones 34 and 35 were similar to cone 33, but the crystals were smaller, more abundant, and more evenly distributed. The amount of glass was lower. The crystallization was nearly complete in cone 36 with only minute quantities of glass. Cones 37 and 38 possessed the dull mat surface, and if glass was present it was not in evidence.

Cone 39 showed a change. Although the surface was still mat, the crystals were warped and broken as

[4] C. W. Parmelee and W. Horak, "Microstructure of Some Raw Lead Mat Glazes," *Jour. Amer. Ceram. Soc.*, **17** [3] 67–72 (1934).

if they had tried to arrange themselves into rounded crystal shapes, though the elongated habit of mullite was the predominant textural feature. Cryptocrystalline corundum crystals were disrupting the mullite pattern. Cone 40 again showed a tendency toward a brighter, glossier surface. The thin section showed an intergrowth of corundum and mullite. The corundum did not form well-defined crystals, but it appeared in some places in sufficient quantity to form a somewhat orientated matrix for the distorted mullite needles. Cone 41 had a semiglossy surface. The needle structure was partly destroyed. Zones of warped needles merged into areas relatively high in corundum and showed a rounded granular texture. Cone 42, composed of pure alumina, had a glossy surface. It was evident that the corundum did not reach any great degree of crystalline development. The best corundum crystals were formed at the surface but were glistening and did not produce the mat texture. Corundum apparently was not as active as mullite in crystallization.

(1) Summary

Mat surfaces and textures may be produced by the rapid development of microcrystalline mullite, even when cooled by fast air-quenching of pure alumina-silica mixtures containing no flux. With rapid cooling, it is necessary apparently to have a silica-alumina ratio equal to that of cone 32 or higher, i.e., 4 molecular parts of silica to 1.0 of alumina, or 2.35 parts by weight of silica to 1 part by weight of alumina, or 70% silica and 30% alumina. (This corresponds to the SiO_2 to Al_2O_3 ratio of leucite.)

III. Al_2O_3–SiO_2–CaO Glazes

Because most commercial mat glazes are complex mixtures of oxides other than CaO, Al_2O_3, and SiO_2, the entire formula in most cases cannot be expressed by this ternary system. The polyoxide systems are not complete, however, and it is necessary to use the data available with the understanding that they are incomplete. It is believed, nevertheless, that the C–A–S system does hold the key oxide ingredients to most mat glazes whether they are fired to cone 32 or to cone 02.

That portion of the C–A–S system which has been used for the mat glazes is the upper or more siliceous corner (Fig. 1(A)), which includes the composition triangles of SiO_2-wollastonite-anorthite and of SiO_2-mullite-anorthite. All of the C–A–S portions of mat glazes studied likewise lie above the kaolin-anorthite composition line; very few of them lie in the wollastonite, the high SiO_2, or the high mullite fields, but the anorthite field is apparently the breeding place.

Any composition lying in the fields mentioned will contain, theoretically, three of the four crystalline compounds after melting and cooling under equilibrium conditions. The first to form will be that in whose field the composition lies; the second may be found by drawing a line from the composition of the primary crystal of that field through the composition in question and extending it to meet a boundary line. The field on the other side of the boundary line determines the appearance of the second crystalline compound. The third is met at the eutectic points (1) or (2). The closer the composition lies to that of one of the compounds the greater the amount of that compound in the final, cooled crystalline mass.

If the flux content is held constant, the addition of mullite, alumina, or clay to a gloss glaze in the lower tridymite field soon requires an increase in temperature to melt the mixture inasmuch as the eutectic valleys in this direction are not very deep. Even that toward "Mount Anorthite" soon rises out of the (1 to 2) valley. That toward CaO keeps to the low temperatures of the valley (2 to 5). If wollastonite has the same ability as anorthite and mullite to crystallize under the conditions used, matness will continue for a considerable lime addition without requiring a rise in temperature. If it is necessary to hold the temperature low, eutectic 5 should be added to the gloss composition.

Berdel and Dannheim[5] in 1932 made a series of alkali-free glazes, composed only of kaolin, flint, and limestone and fired to cone 13 in a commercial kiln. The results (shown in Fig. 1(B)) indicated that ten of the mat glazes lay in the anorthite field, one in the mullite, and two in the wollastonite field. In all cases, the glossy glazes of the same CaO to Al_2O_3 ratios were more siliceous although three lay in the wollastonite and two lay in the anorthite field. Although Berdel and Dannheim made use of the lime-alumina-silica

[5] E. Berdel and G. Dannheim, "Alkalifreie Kalkglasuren," *Ber. deut. keram. Ges.*, **13** [1] 20–27 (1932); *Ceram. Abs.*, **11** [9] 497 (1932).

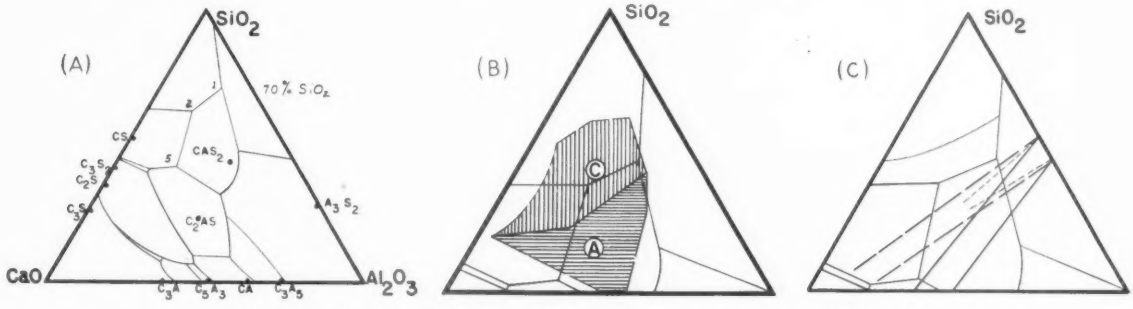

FIG. 1(A).—CaO–Al_2O_3–SiO_2 equilibrium system; Rankin and Wright, revised.
1(B).—CaO–Al_2O_3–SiO_2 glazes of Berdel and Dannheim; (*A*) mat glazes, (*C*) gloss glazes.
1(C).—CaO–Al_2O_3–SiO_2–feldspar porcelain glazes of Stull.

diagram, they did not refer to the importance of the three minerals which apparently caused the development of the mat texture. The line dividing the mat and gloss compositions, if extended to the Al_2O_3-SiO_2 boundary, passes between the compositions of cones 31 and 32 and thus, in a manner, checks with the Orton cone data, although different raw materials, firing temperatures, and rates of heating and cooling were used.

IV. Al_2O_3–SiO_2–CaO–Feldspar Glazes

Stull[6] in 1912 made a series of porcelain glazes of the following type:

$$\left.\begin{matrix}0.3\ K_2O \\ 0.7\ CaO\end{matrix}\right\} 0.3\text{–}1.0\ Al_2O_3 \qquad 1.8\text{–}7.2\ SiO_2$$

These were fired in a laboratory kiln to cone 11 in 36 hours. Figure 1(C) shows Stull's data replotted on the CaO–Al_2O_3–SiO_2 diagram. The gloss area above is separated from the mat below by the semimat area between the lines. The lightly dotted lines indicate the lime-silica-alumina compositions of the glaze as a whole, i.e., including the alumina and silica from the feldspar as well as from the clay and flint. The heavy full lines indicate the compositions from which all the alumina and silica of the feldspar had been subtracted. This was done according to the theory that during the period of melting the silica in the feldspar does not break away from the molecule for reaction with the other ingredients. This view, however, is not tenable for temperatures corresponding to that of cone 11 (1325°C), for Bowen and Morey[7] have shown that orthoclase becomes unstable at 1170°C, changing to leucite and liquid and throwing off two molecules of silica which may have more freedom for combination with other ions than the remaining four molecules in the melted leucite. The dash lines therefore were used to indicate the compositions after subtracting the alumina and silica of leucite.

The direction of all three lines separating the semimat area from the mat area, when extended from Stull's data, intercepted the Al_2O_3–SiO_2 binary system close to the composition of cone 32. This may be a coincidence without sufficient supporting evidence, but it may also be an easy method to indicate the texture of a glaze from its composition. The direction of the lines indicates that as the lime content of a glaze decreases, the dividing composition of the mat and gloss glazes approaches 30% Al_2O_3 and 70% SiO_2.

Thompson[8] duplicated a large portion of Stull's compositions with analyzed raw materials and made petrographic examinations of the glazes as well as a mineral study of special glass melts. This excellent work is one of the landmarks in the development of the present knowledge of mat-glaze structure. Firings were made to cones 10 and 12. Because the field of well-developed glazes and of the mat glazes was extended by the higher temperature, it alone will be considered.

[6] R. T. Stull, "Influences of Variable Silica and Alumina on Porcelain Glazes of Constant RO," *Trans. Amer. Ceram. Soc.*, **14**, 62–70 (1912).

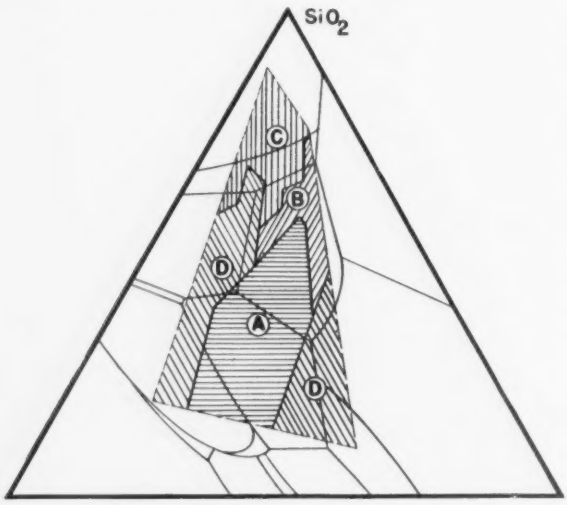

FIG. 2.—CaO–Al_2O_3–SiO_2–feldspar porcelain glazes of C. L. Thompson, minus entire alumina and silica of feldspar; (*A*) mats, (*B*) semimats, (*C*) gloss, (*D*) immature glazes.

[7] G. W. Morey and N. L. Bowen, "Concentration-Temperature Diagram of the System Leucite–Silica," *Amer. Jour. Sci.*, **4**, 10 (1922).

[8] C. L. Thompson, "Microstructure of Some Porcelain Glazes," *Univ. of Ill. Eng. Expt. Sta. Bull.*, No. 225, 24 pp. (1931); *Ceram. Abs.*, **10** [6] 463 (1931).

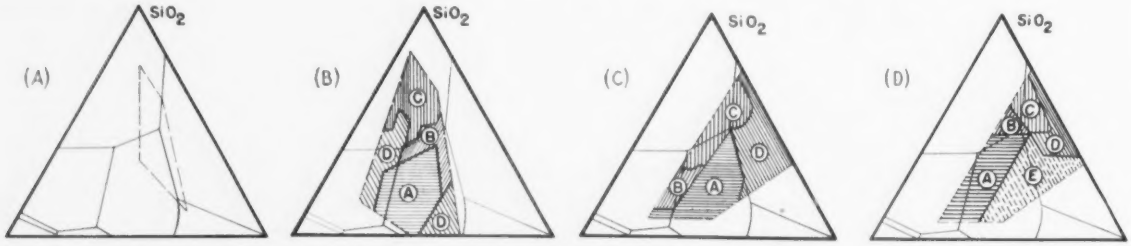

FIG. 3(A).—CaO–Al_2O_3–SiO_2–feldspar porcelain glazes of C. L. Thompson, using total silica and alumina.
3(B).—CaO–Al_2O_3–SiO_2–feldspar porcelain glazes of C. L. Thompson, based on formation of leucite; (*A*) mats, (*B*) semimats, (*C*) gloss, (*D*) immature.
3(C).—CaO–Al_2O_3–SiO_2–feldspar–ZnO terra-cotta glazes fired in laboratory kiln to cone 5; (*A*) mats, (*B*) semimats, (*C*) gloss, (*D*) immature.
3(D).—CaO–Al_2O_3–SiO_2–feldspar–ZnO terra-cotta glazes fired in commercial terra-cotta kiln to cones 6 to 7; (*A*) mats, (*B*) semimats, (*C*) gloss, (*D*) immature, (*E*) see text, p. 451.

Figure 2 shows Thompson's glazes recalculated and placed on the $CaO–Al_2O_3–SiO_2$ diagram. In this calculation, the entire silica and alumina of the feldspar was omitted. The apparent location of the compositions on the diagram is not in accord with the minerals identified by Thompson who found anorthite to be the main constituent of Nos. 50, 65, 66, 81, and 82. These compositions, according to the first calculation, lie in the gehlenite and dicalcium silicate fields, and neither of these minerals was identified by Thompson.

Figure 3(A) shows the location of the glaze compositions calculated on the basis of total silica and alumina. The calculation is based on the assumption that all of the silica and alumina of the feldspar is free for combination with clay and flint. This method theoretically corresponds with Thompson's mineralogical determination except for the series 1 to 16, 17 to 32, and 33 to 48 which should have shown some mullite crystals with the anorthite.

The third and best method of calculation, shown in Fig. 3(B), was based on the formation of leucite. In other words, 1 mol of alumina and 4 of silica were subtracted from the total composition, and the percentages of lime, alumina, and silica were determined in the remainder. This places practically all of the mats and semimats in the anorthite field or its boundaries (a little in the wollastonite field) with two exceptions which are very close to the tridymite-anorthite boundary.

The minerals which could be formed from these compositions theoretically would be primary tridymite from the tridymite-cristobalite field, primary anorthite from its field, and primary wollastonite from the compositions in its field. The secondary and tertiary minerals in the order of crystallization would include corundum along the lower right-hand side of the anorthite field, gehlenite along the lower left-hand boundary, and wollastonite on the left boundary. Tridymite was mentioned by Thompson as devitrification rims around the undissolved quartz particles, but owing to the sluggishness of inversion it is not expected to be a factor in the crystallinity of these fast-melted and fast-cooled glazes. Mullite is not mentioned by Thompson, but it may be represented by the "minute needles" of glazes 5 to 16 along the mullite boundary. The glazes along the corundum boundary were immature and alumina did not have a chance to crystallize. No gehlenite crystals were found in the matured glazes along the gehlenite boundary, but anorthite was common. Fibrous wollastonite crystals were found near the ternary eutectic as expected.

These results indicate that anorthite was the primary cause of microcrystalline development of the mat structure and texture, with wollastonite of probable importance in the compositions of lower alumina content. Mullite, a rapidly crystallizing compound, had a possible but unidentified appearance. Very few of the compositions shown in Fig. 3(B), however, should theoretically include mullite because the location of anorthite is so close to the anorthite-mullite boundary.

V. $Al_2O_3–SiO_2–CaO$–Feldspar–ZnO Glazes

Further studies were made with glazes corresponding to those used in the manufacture of architectural terra cotta. Zinc oxide was added to the clay, flint, whiting, and feldspar of the previous studies, and, by the use of this common flux, the firing temperatures were reduced from those of porcelain glazes to the range of cones 6 to 8. The feldspar ("Keystone regular potash" feldspar from the Black Hills of South Dakota) was held constant at 40% and the zinc oxide at 10%. The lime, alumina, and silica were varied as shown in Figs. 3(C) and (D) and 4(A). When the clay content exceeded 12.5%, the excess was added as calcined china clay. Sixty-four samples with 5% composition intervals were made by weighing and grinding the corner members and by blending the aqueous slips. Three trials were sprayed simultaneously on white, biscuit wall tile and fired to cone 5 in a laboratory kiln in ten hours, to cones 6 to 7 in a commercial terra-cotta kiln in eighty hours, and to cone 8 in a laboratory kiln in twelve hours. The data in Figs. 3(C) and (D) and 4(A) indicate the proportions calculated from the total $CaO–Al_2O_3–SiO_2$ contained in the formulas. A shift of 3.7% should possibly have been made away from the silica corner to provide for the formation of willemite.

The following results were noted: (1) The area of undeveloped glazes for the most part lay in the mullite field in the cone 5 laboratory firing, but a large portion of these glazes was matured in the cone 8 laboratory firing. (2) At cone 5, the mat area extended close to the mullite–silica–anorthite eutectic, but at higher temperatures it was pushed back by the flood of gloss glazes and over in the mullite field. (3) The mats and semimats of the anorthite-wollastonite boundary line at cone 6 were practically replaced by gloss glazes at cone 8. Higher temperatures probably caused more quartz to dissolve in the more siliceous members and produced more fluidity in the mullite refractory compositions. (4) The longer soaking periods of the commercial terra-cotta kiln increased the mat areas at the expense of the gloss, but they likewise introduced a large area of devitrified, overdeveloped mats, which were rough and unpleasing to sight and touch (shown in field E, Fig. 3(D)).

Hill[9] fired a number of glazes in a commercial terra-cotta kiln, but most of them were very siliceous and clearly in the silica field of the $CaO–Al_2O_3–SiO_2$ diagram when free of barium which added mathematical complications. A number of calculations were made on the basis that BaO plus CaO equalled CaO by weight. This empirical method indicated that Hill was working around the boundaries of the silica-anorthite and the anorthite-wollastonite fields so that the mats were not numerous because of the small amounts of anorthite crystallization.

VI. $Al_2O_3–SiO_2–CaO–PbO$ Glazes

In 1917, Staley[10] developed a systematic series of

[9] E. C. Hill, "White Terra-Cotta Glazes at Cones 6 and 7," *Trans. Amer. Ceram. Soc.*, **17**, 380–408 (1915).

[10] H. F. Staley and L. C. Hewitt, "Cost of Raw Lead Glazes," *ibid.*, **19**, 659–73 (1917).

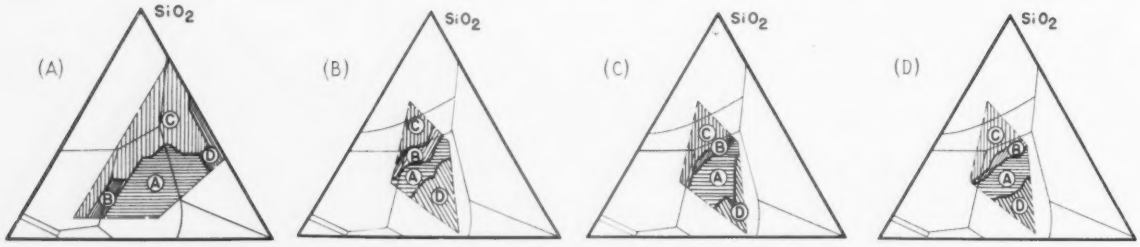

FIG. 4(A).—CaO–Al_2O_3–SiO_2–feldspar–ZnO terra-cotta glazes fired in laboratory kiln to cone 8.
4(B).—CaO–Al_2O_3–SiO_2–PbO glazes of Parmelee and Horak; series P fired to cone 03; (*A*) mats, (*B*) semimat and semibright, (*C*) gloss, (*D*) immature.
4(C).—CaO–Al_2O_3–SiO_2–PbO glazes of Parmelee and Horak; series P fired to cone 2.
4(D).—CaO–Al_2O_3–SiO_2–PbO glazes of Parmelee and Horak; series P, cone 4.

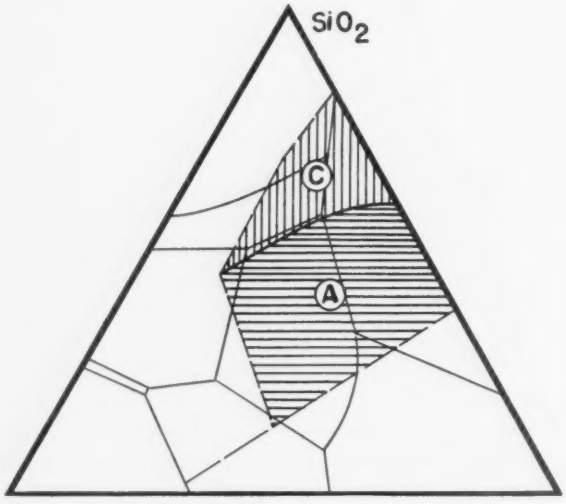

FIG. 5.—CaO–Al_2O_3–SiO_2–PbO raw glazes of Staley; (*A*) mats, (*C*) gloss.

gloss and mat glazes of the feldspar, lime, lead oxide, clay, and flint variety shown in Fig. 5. With the powerful fluxing effect of lead oxide and the low viscosity of the resulting melts, both the mullite and anorthite fields are breeding areas for mat glazes. It is interesting to note that the division line between mat and gloss glazes likewise terminates near 30% alumina composition in the Al_2O_3-SiO_2 boundary.

Parmelee and Horak,[4] in 1934, fired a series of lead, lime, aluminum silicate glazes in a laboratory kiln to cones 03, 2, 4, and 6, finishing at a rate of 20°C per hour followed by a 2-hour soaking period. No feldspar was present in this case to confuse the results. Their conclusions which include the microscopic examination of other similar series containing barium and zinc oxides were as follows: (1) "Crystallization is responsible for the characteristic texture of all the glazes in the mat and semimat areas . . . (3) In mat glazes containing lime, the principal crystals are anorthite; wollastonite is less common, but more of it occurs in the low-alumina, high-silica field. (4) When zinc oxide is under 0.3 equivalent no zinc silicate crystallizes out, but the zinc combines with the other constituents to form a more fluid glass. (5) Barium tends to form mats by crystallizing out as a mineral believed to be a barium feldspar."

Their data were recalculated to the percentage CaO–Al_2O_3–SiO_2 basis and plotted in Figs. 4(B), (C), (D) to 6(C), inclusive, which indicate that the mat areas were increased in size when the temperature was raised from cone 03 to cone 2, probably because of the lack of proper development at the lower temperature. The mat area remained approximately the same at cone 4 but was reduced in size by the encroachment of the brighter glazes at cone 6. The immature glazes on the high-alumina, low-silica side were gradually replaced by mats as the temperature was raised. The mat area was practically confined to the anorthite field, but only a few of the compositions lay in the wollastonite field and none was placed in the mullite field. All of those in the silica field were glossy. The authors state that the mat glazes of series P (shown in Figs. 4(B), (C)(D) to 6(A), inclusive), and the series A (containing barium and not shown here) "consisted of crystals of anorthite and wollastonite imbedded in a glassy matrix . . . The anorthite seemed to predominate, though no attempt was made in any case to determine the relative amounts of the crystals formed or to measure their size." The authors did not state which compositions contained wollastonite or if the location of the mat areas in the composition triangle, anorthite–wollastonite–silica, indicated that anorthite was the predominant crystalline form, with wollastonite second in the lead-silicate glass. If sufficient silica were calculated as uniting with the PbO to form lead metasilicate, the remaining CaO–Al_2O_3–SiO_2 would be moved down into the gehlenite, alumina, and dicalcium-silicate fields. This calculation does not indicate the true mineral structure as revealed by the microscopic examination that showed only anorthite and wollastonite.

When the 0.60 equivalent PbO is calculated as combining with 0.3 equivalent SiO_2 to form $2PbO \cdot SiO_2$, the area tested is lowered and expanded in the triaxial diagrams to cover the anorthite field, except on the mullite and corundum boundaries, with slight overlappings onto the wollastonite and gehlenite fields. The principal changes, therefore, are an expansion of the mat and gloss areas, and a greater proportion of the gloss areas in the anorthite field. The PbO content ranged from 44.5% in P–12 to 64.2% in P–61.

Figures 6(B) and (C) are recalculations of the Parmelee and Horak data of the C series containing ZnO. The mat and the immatured areas have been reduced and the gloss area has been expanded. The

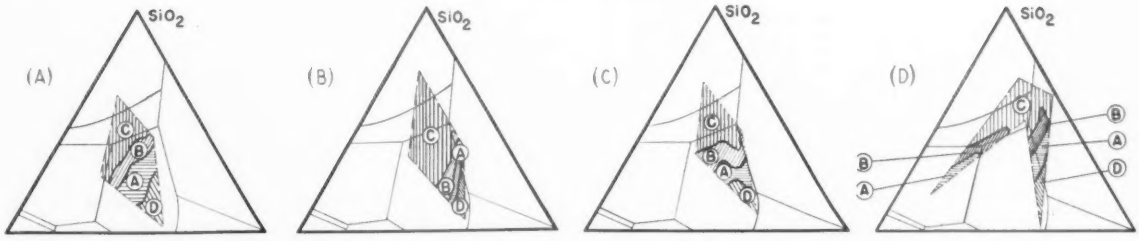

FIG. 6(A).—$CaO–Al_2O_3–SiO_2–PbO$ glazes of Parmelee and Horak; series P, cone 6.
6(B).—$CaO–Al_2O_3–SiO_2–PbO–ZnO$ glazes of Parmelee and Horak; series C, cone 4.
6(C).—$CaO–Al_2O_3–SiO_2–PbO–ZnO$ glazes of Parmelee and Horak; series C, cone 6.
6(D).—$CaO–Al_2O_3–SiO_2–PbO$–feldspar glazes of Whitford; (*A*) mats, (*B*) semimats, (*C*) gloss, (*D*) immature.

data indicate that the ZnO has combined with certain of the mat-forming ingredients to increase the amount of glass and to decrease the amount of microcrystalline material. Members Nos. 13 through 21 were made at the University of Washington to check the peninsula of gloss glazes which penetrated the mat area at No. 19. The new data did not check the old, and it is believed that the textural properties could be shown by straight lines instead of the loops.

The author has not found that ZnO contributes to the mat texture of glazes but has used many mat glazes which depended upon ZnO as a secondary flux to feldspar or lead oxide.

VII. $Al_2O_3–SiO_2–CaO–PbO$–Feldspar Glazes

Whitford[11] made two series of glazes called the anorthite series and the wollastonite series. A few mat glazes were noted between the semimats, which lay adjoining the bright glazes, and the immature. Firings were made to cones 05, 02, 1, and 3 in a 16-hour firing in a laboratory kiln. Whitford concluded that "matness was a function of temperature and composition, a certain minimum content of anorthite norm being essential at each heat treatment. The line dividing dull finish from bright glazes was fixed by this minimum anorthite content and bore no relation to oxygen ratios. Glazes made from blends of wollastonite norm with lead metasilicate norm and orthoclase were mostly bright. The few mats developed were of silky texture and had quite low alumina contents. The line dividing dull finish from bright glazes was fixed at each temperature by a certain minimum wollastonite norm content."

When the glaze compositions were recalculated for the $CaO–Al_2O_3–SiO_2$ diagram using all the alumina and silica from the feldspar, the arrangement in Fig. 6(D) was found. This indicates that the compositions just bordered the anorthite field and thus missed the present commercial mat area. When the glazes were calculated on the leucite and feldspar-elimination plan, Whitford's areas became single lines with mat and gloss glazes overlapping in a confused, irregular manner.

Keeler[12] tested thirteen series of feldspathic glazes containing variable RO, alumina, silica, and tin oxide.

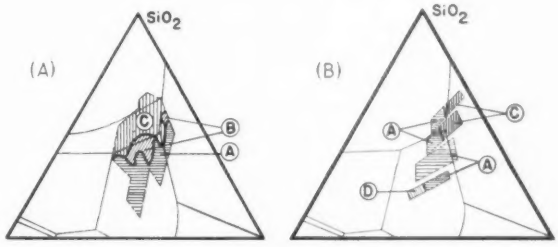

FIG. 7(A).—Complex feldspathic glazes of Keeler.
7(B).—$CaO–Al_2O_3–SiO_2–PbO$–feldspar glazes of Potts; cone 4.

The trials were fired in commercial muffle kilns between cones 2 and 5 in fifty to seventy hours. The RO showed the following range:

	Mol. equivalent		Mol. equivalent
K_2O	0.04–0.4	MgO	0.00–0.11
CaO	.17– .54	BaO	.00– .10
ZnO	.25– .40	PbO	.00– .10

The tin oxide ranged from 0 to 0.12 equivalent. Keeler claimed that the alumina and silica could be varied to accommodate any RO combination within these limits to produce all textures of glaze finish. Because of the complexity of the RO and the presence in most glazes of three similar mat-forming bases, CaO, MgO, and BaO were made equal, pound for pound, and were considered to be CaO in Fig. 7(A), which represents a summary of eight of his series. The remaining series, which in part were duplicates of portions of the eight, do not agree with the former series and with the general ideas of this thesis because they show mat and semimat glazes well within the silica field. Keeler explains the matness of these higher silica members by the action of SnO_2 and shows that, although his data indicate a matness with an Al_2O_3 to SiO_2 ratio of 1 to 4.6 with 0.0 SnO_2, the ratio is increased to 1 to 7.2 with a SnO_2 molecular content of 0.12 equivalent. The disagreement was all in the same direction, i.e., the mat area shifted toward the silica field and the gloss area did not penetrate the anorthite field. The data also indicate that for general comparisons, CaO, MgO, and BaO may be considered to be CaO on the weight basis.

Potts[13] made four series of glazes designed on the normative system. He belittled the effect of leucite and

[11] W. G. Whitford, "Study of Three Component Normative Systems in Raw Lead Glazes," *Trans. Amer. Ceram. Soc.*, **19**, 312–30 (1917).

[12] R. B. Keeler, "Influence of Variable Silica and Alumina on Terra-Cotta Glazes," *ibid.*, **18**, 282–314 (1916).

[13] A. P. Potts, "Notes on Mat Glazes," *ibid.*, **15**, 628–43 (1913).

emphasized the effect of orthoclase in comparison to anorthite in the production of mat textures. The majority of Pott's mat glazes, however, lie in the anorthite field according to the suggested method of calculation (Fig. 7(B)), which covers his cone 4 firing. Each shaded area represents a series with No. 1 at the top and No. 4 at the bottom. All the SiO_2 and Al_2O_3 have been used in the calculation. The content of PbO increases in each series from left to right. Series Nos. 1 and 2 at cone 4 showed gloss with the higher lead oxide contents, but they were mat at low temperatures.

VIII. Concluding Discussion

It is interesting to note that the foregoing hodgepodge of mat-glaze data, covering a wide range in composition, firing temperatures, operating conditions, and raw materials, has a common meeting ground in the anorthite field when a limited selection of the fast crystallizing, mat-forming minerals is arranged according to one or more of three methods of calculation:

(1) That which considers the total CaO–Al_2O_3–SiO_2 content of the glaze, including orthoclase, and indicates that all portions of the feldspar can combine freely with the other components. This is more apparent at the higher temperatures, with the greatest chemical attack, and under equilibrium conditions.

(2) That which excludes the Al_2O_3 and SiO_2 of leucite, leaving 21.6% SiO_2 of the original orthoclase for free combination with the mat-forming components. Orthoclase dissociates at 1170°C (cone 4), but this temperature undoubtedly varies with the composition.

(3) That which excludes all of the Al_2O_3 and SiO_2 of feldspar on the theory that at low temperatures and fast heating feldspar melts to a glass but does not necessarily enter into chemical reaction.

The release of silica from some well-distributed internal source affords an explanation for the change of certain mat glazes to gloss glazes when the temperature is raised.

While the data point to anorthite as the most common mat-forming mineral, mullite is indicated in the low-lime and lime-free glazes. The role of wollastonite is less clear. Apparently a number of mats lie in the wollastonite-anorthite valley between points 2 and 5, but the basic glazes from which appreciable quantities of wollastonite may be calculated are rare. Gehlenite and corundum are eliminated because of refractoriness; also ceramists have not used an alumina to silica ratio greater than kaolin.

The study is handicapped by the lack of commercial mat glazes, petrographic analyses, knowledge of the relative affinities of the basic ingredients for silica and alumina, and the rate of crystallization of the synthetic minerals. The maximum amount of glass-forming feldspar, lead oxide, and other fluxes that may be used in mat glazes of different compositions and various temperatures should be determined.

Acknowledgment

Grateful acknowledgment is given to the many students of the University of Washington who have assisted in the laborious recalculation of these glazes and to K. G. Skinner and R. E. Zane for the drawings.

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SERVICEABILITY OF POTTERY PLASTERS:
I, RELATION OF PHYSICAL PROPERTIES TO SERVICEABILITY*

By J. F. McMahon and H. G. Schurecht

Abstract

The physical properties of plasters were compared with the serviceability of casting and jigger molds. The plasters that gave good jigger service had high compressive strength; they were hard and fairly resistant to abrasion; and they had low rates of absorption. Plasters that gave good casting service usually had good compressive strength and high rates of absorption, whereas their hardness and resistance to abrasion were not necessarily good.

I. Introduction

Tests were conducted on ten plasters, furnished by four producing companies, which represented five production areas. The W to P ratios (ratios of weight of water to that of plaster) were determined in the laboratory so that under similar conditions of mixing, soaking, and stirring all of the plasters would have similar pouring consistencies (Table I).

(1) Plant Tests

The kinds of molds made for the plant tests are shown in Table II.

The test molds were put into regular service by the coöperating potteries. The shop foreman recorded the condition of the molds at frequent intervals. When the molds had served their usefulness as judged by the foreman, the records and the molds were sent to this laboratory for study.

* Presented at the Fortieth Annual Meeting, American Ceramic Society, New Orleans, La., March 31, 1938 (White Wares Division). Received June 15, 1939.

TABLE I

W/P RATIOS AND STIRRING TIME

Plant No. 1			Plant No. 2			Plant No. 3		
(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
			Casting molds					
1B	80.0	7	A	78.5	4	3B	80.0	6
C	81.0	6½	2B	80.0	6	F	86.5	5–8
D	76.0	5	E	85.0	5	I	53.0	8
G	101.0	8	H	78.0	4	3R		6
1R		7						
			Jigger molds					
1B	72.0	5	A	72.0	2	3B	72.0	4
D	69.0	3	2B	72.0	4	F	76.5	5
G	86.5	6	E	76.0	3	I	47.0	7–11
1R		6	H	70.0	3	J	46.0	8
			2R		3	3R		3

Column (1) plaster; (2) parts water added to 100 parts plaster; (3) stirring time (minutes).

TABLE II

TYPE OF MOLDS USED FOR PLANT TESTS

Plant No.	Casting molds	Jigger molds
1	Gravy bowls	4-in. plates
2	York creamers	" " "
3	Celery trays	3-in. "

II. Laboratory Tests

One-inch cubes were cut from the sample casts made from the same plaster batches from which the molds had been made. These cubes, therefore, were identical in structure with that of the test molds. All cubes were dried at 100°F before they were tested. The tests included compressive strength, hardness, resistance to abrasion, density, and absorption.

(1) Hardness Test

Hardness was determined by pressing an 11-mm. steel ball into the plaster with a pressure of 110 pounds for 20 seconds. The diameter of the resulting impression was measured. The average of nine such tests was determined for each plaster. The Brinell hardness numbers were calculated from the following formula:

$$H = \frac{P}{\pi D\left(\frac{D}{2} - \sqrt{\frac{D^2 - S^2}{4}}\right)}.$$

Where H = Brinell number.
P = load on ball (kg.).
D = diameter of ball (mm.).
S = diameter of indentation (mm.).

(2) Abrasion

The resistance of plasters to abrasion was determined by placing two cubes, previously weighed, in an empty, standard assay ball-mill jar (8 by 9 inches) which was turned at 60 r.p.m. for 20 minutes. The specimens were then reweighed and the average percentage loss in weight was calculated.

(3) Absorption

The percentage of absorption was determined with specimens, 1 by 1 by 1½ inches, cut from the sample casts, which were submerged in water until they reached constant weight. The increase in weight of the specimens over that when they were dried at 100°F was used to calculate the percentage absorption. The average of ten such determinations was obtained for each plaster.

(4) Density

Density determinations were made on the same specimens, the volumes being determined by the suspended-weight method.

(5) Absorption Rates

The rate absorption was determined on laboratory-made specimens, employing the same W to P ratios and the mixing procedure used in the plant tests. The water used to make the specimens was supplied by the different plants.

A conical glass tube, 2 cm. in diameter at the base, 2 cm. high, and 0.25 cm. at the top, was placed on a flat surface of the specimen, with a vaseline seal between the ground base of the tube and the plaster. One cubic centimeter of distilled water was placed in the tube by means of a pipette, and the time necessary for complete absorption to take place was noted. The rate (cc./sec.) was calculated, and the average of ten such determinations was obtained for each plaster.

III. Results

The results of the plant tests are given in Tables III and IV. The plasters have been rated according to their serviceability. Those which gave better results than standard plaster B were classed as No. 1 plasters; those on a par with B were classed as No. 2 plasters; and those that did not test as well as B were classed as No. 3 or No. 4, depending on their

TABLE III

CONDITION OF CASTING MOLDS AFTER SERVICE TESTS

Plant No. 1			Plant No. 2		Plant No. 3	
Rank	Plaster	Condition of molds after 20 to 30 fillings	Plaster	Condition of molds after 46 fillings	Plaster	Condition of molds after 100 fillings
1	1R	Worn out in one case; starting to wear in three	E	Very good; may still be used long time		
2	1B	Worn out in three cases; starting to wear in fourth	2B	Fair; good for about 12 more turns	3B 3R F	Worn out
3	C	Worn out in three cases; almost worn out in fourth	A	Worn out		
4	D	All molds worn out	2R	Worn out	I	Would not release from molds after 20 fillings
4	G	Worn out before other plasters				

TABLE IV

CONDITION OF JIGGER MOLDS AFTER SERVICE TESTS

Plant No. 1			Plant No. 2		Plant No. 3	
Rank	Plaster	Condition of molds after 49 turns	Plaster	Condition of molds after 41 turns	Plaster	Condition of molds after 39 turns
1					J	Good for several more after 39 turns
1					I	Starting to scale on rim; two still good
1			E	Very good; hardly any wear	3R	Faces and rims good; ball shows wear
2	1R 1B C	Worn out	2B	Pinholes commencing to appear	3B F	Faces and rims good; balls badly worn
3	D	Worn more than 1B and C	H	Molds were half worn out in cases		
4	G	Badly worn	2R	Badly pinholed		
4			A	Burned after 20 turns		

TABLE V

PHYSICAL PROPERTIES OF PLASTERS

		Hardness						
Rank	Plaster	Impression diameter (in.)	Brinell hardness No.	Abrasion test (% loss in wt.)	Compressive strength (lb./in.²)	Density (g./cc.)	Absorption (%)	Absorption rate (cc./sec.)
				Casting molds				
1	E	0.216	1.9	7.5	1438	0.934	56.0	0.125
1	1R	.197	2.4	6.9	1391	1.01	45.4	
2	1B	.206	2.2	7.0	1297	0.983	46.4	.100
2	2B	.190	2.6	6.0	1331	0.995	45.6	.100
2	3B	.193	2.5		1617	1.02	43.8	.100
2	3R	.193	2.5	7.6	1775	1.01	43.0	
2	F	.217	1.9		1272	0.941	50.6	.079
3	C	.213	2.0	7.2	1266	0.967	50.0	.110
3	A	.210	2.1	7.5	1332	0.966	48.3	
4	I	.126	6.0	4.8	2613	1.33	29.1	.033
4	D	.170	3.3	5.2	1510	1.06	40.8	.063
4	G	.307	0.89	14.0	650	0.789	72.9	
				Jigger molds				
1	J	0.100	9.4	4.03	3318	1.43	21.4	0.029
1	I	.120	6.6	4.56	2474	1.33	28.1	.033
1	3R	.170	3.3	5.47	1949	1.10	36.9	
1	E	.183	2.8	7.3	1388	0.997	49.8	.130
2	1B	.180	2.9	6.4	1506	1.04	43.2	.078
2	1R	.190	2.6	6.60	1560	1.02	43.5	
2	C	.190	2.6	6.9	1259	1.02	42.1	
3	H	.180	2.9	6.2	1738	1.03	42.6	.079
3	D	.180	2.9	6.60		1.05	38.6	.040
4	G	.246	1.5	11.70	741	0.884	56.9	

behavior. The results of the physical tests are shown in Table V.

(1) Service Tests

Casting molds made from regular pottery plasters failed from pinholing and surface wear. Molds made of special plaster I, owing to their low rates of absorption, would not permit ware cast in them to release within a reasonable length of time; they did not fail because of surface wear, but their low rates of absorption caused them to be unsuitable for casting molds.

Jigger molds, with two exceptions, failed because of pinholing and surface wear. Jigger molds, made from plaster A, burned up after 20 turns while they were in the mold drier. Those produced from plaster I scaled along the rim (Table IV). Special pottery plasters, I and J, gave excellent results when they were used for jigger molds.

Each pottery had its own criteria by which failure was judged, and the condition of the molds at the time of failure therefore varied. The standard plaster, B, which was used as a gauge, gave direct comparisons of the number of turns obtained at the different potteries, and the comparative lives of the molds were judged fairly well by reference to these standards.

IV. Summary

(1) The properties of a plaster that are conducive to good jigger service do not necessarily contribute to good casting service.

(2) Practically all plasters that give the best jigger service have high compressive strength, and, in general, they are comparatively hard and show good resistance to abrasion.

(3) Nearly all plasters that give good casting service have good strength and comparatively high rates

of absorption, whereas their hardness and resistance to abrasion are not especially good.

(4) The limiting values of the physical properties for the plasters that give good serviceability are as follows:

Property	Casting molds	Jigger molds
Hardness (Brinell No.)	1.9–2.6	2.6–9.4
Abrasion resistance (% loss)	6.0–7.6	4.0–7.3
Compressive strength (lb./in.^{2})	1272–1775	1259–3318
Density (g./cc.)	0.934–1.02	0.997–1.43
Absorption (%)	43–56	21.4–49.8
Absorption rate (cc./sec.)	0.079–0.125	0.029–0.13

Acknowledgment

The writers acknowledge the valuable help of the Onondaga Pottery Co., the Buffalo Pottery, and the Iroquois Pottery who conducted the plant tests on molds made from the test plasters, as well as the coöperation of the United States Gypsum Co., the Certain-Teed Products Corp., the National Gypsum Co., and Hammill & Gillespie, Inc. M. E. Holmes also gave helpful suggestions during the course of this investigation.

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CERAMIC DESIGN AND THE MARKET*

By John A. Foster

At a recent studio exhibition of a group of painters and sculptors, the art critic of one of the metropolitan papers, in speaking of ceramics, decried muddy colors, pots that leak, and kindergarten design.

The writer, in another instance, took part in a discussion in a group which included an artist painter, an architect and interior designer, and a potter. The group was agreed that, generally speaking, American ceramic ware is pretty "lousy" and that something should be done about it.

A representative of one of the largest manufacturers of fine lamps in this country stated that his business was going to pot because it was becoming increasingly difficult to import fine ceramic ware from abroad owing to unsettled political situations. In the past, the entire output of this company has been the fabrication of lamps with bases imported from England, the Continent, and the Far East. The argument of this man, in justification of the use of foreign goods, included severe criticism not only of the apparent relish of the American public for anything "imported" but also criticism of the attitude of the American designer and manufacturer toward the market. American ceramic designers and manufacturers, he stated, are unresponsive to his analysis of the marketability of various types of ware—that he knows what will sell in different localities but that he cannot obtain it from American manufacturers. He can go into a pottery in Italy, explain in a few words what he needs, and before he leaves the artisans have prepared for his inspection models based on his recommendations; in this country, he is told curtly by a pottery producer, "here is the line for the current year—take it or leave it."

Ceramic designers, however—individual craftsmen who are doing splendid work—have often complained of the indifference of manufacturers to their work.

To what does this all add up? These statements indicate a complete lack of understanding, integration, and coördination among the various elements comprising this commerce.

Upon analysis, it is obvious that the manufacturer and the designer need to be educated and in turn act as educator to the public. The manufacturer must be the vehicle or medium to carry out this educating process, and he must be shown that his efforts will be a profitable investment.

The public first needs to become acquainted with the fact that this country is eminently equipped to produce ware of sound design and technical perfection comparable with, if not superior to, anything procurable elsewhere. This statement is not an idle boast; it is simple logic, based upon the abundance and availability of highly suitable raw materials, the pace-setting advance in ceramic technology taking place in this country today, highly developed educational systems training specialists in every field including that of design, and finally the fundamental fact that Americans are at least the intellectual equals of any other people.

The question is—how may the process be carried out?

There is only one answer. The responsibility rests with the individuals who are being trained to the recognition, appreciation, and, let us hope, the not-too-painful execution of the best in design.

England, France, the Scandinavian countries, or the East produce typical styles that are the expression of the people of those countries.

Years are required, it is true, for such developments, and our country is still young by comparison, but surely we are a generation of typical Americans if there is ever to be one, and the development of a worthy American style depends upon us.

To accomplish this, it is highly important to acquire a broad background of knowledge of what has been accomplished in the past and of what is now considered to be best in other countries. The fundamental laws of line, form, and color, then, should be employed to influence use of native materials, modern equipment, and latest technological findings to produce a finished

* Presented at the Forty-First Annual Meeting, American Ceramic Society, Chicago, Ill., April 19, 1939 (Art Division). Received May 8, 1939.

product that *will not have to be sold*, but, by reason of its very excellence, *will sell itself*.

The designer of ceramics, to attain this end, must be acquainted with the possibilities and limitations of ceramic materials and tools. The manufacturer of automobiles must know the machines and materials with which he works; he might otherwise lay out a beautifully shaped fender which cannot be pressed or a wheel which has no strength.

The buying public, it is agreed, needs acquaintance with native American possibilities. Obviously, the best way to accomplish this is through the execution and exhibition of ceramic works of the highest quality.

That this fact is gradually being recognized is evidenced in the establishment, as a national institution, of the annual National Ceramic Exhibition at Syracuse, New York, and the many local showings which take place from time to time in other parts of the country. It is largely through efforts in this direction that the public will learn to know, grow to admire, and finally to demand the best of which we are capable.

It is on this basis alone, namely public demand, that the ceramic manufacturer is guided if he is to make a financial success of his enterprise.

Unfortunately, he is not primarily concerned, as to whether or not the demand is in good taste. If the public wants gilded and decaled flowerpots in the shape of birds' nests he will make them, although he might wish that public preference turn to a simplified form of beautiful line, harmonious color, and fine quality glaze.

If the public taste, on the other hand, is educated through repeated display and exhibition to the recognition and appreciation of beautiful line, color, and quality, the manufacturer will be only too eager to supply a quality ware to meet the consequent demand.

One of these days, perhaps, the lamp manufacturer previously mentioned may see such possibilities, and he may announce a national open competition and purchase prizes, for instance, for the best dozen lamp bases designed according to definite specifications and to be judged by a properly selected committee.

Only a small investment would be required on the part of the manufacturer for such a contest, and he undoubtedly would be rewarded with generous dividends.

Think of the tremendous publicity possibilities for the sponsor and the ultimate sales value to the manufacturer resulting from such a competition. Think of the incentive to individual potters and ceramic groups. Here would be an actual practical problem in the design of quality domestic ware to inspire students throughout the country.

Here, for example, is a class in ceramic design in some college and there, a local group making pottery. The competition is announced. The individuals in the various groups compete among themselves. The best designs are chosen and carried out as individual or group projects. The designs and photographs of the completed works are submitted to the committee for preliminary consideration, and a certain number of pieces are chosen finally for the ultimate jury selection and public exhibition.

Ceramic manufacturers who complain that they cannot afford to put expensive designers on their payrolls should be quick to see the value of procuring, in this way, the services of the young designers of tomorrow and the freshness of their inspiration practically at no cost other than the purchase price of the pieces themselves.

A beginning has been made in this direction by the Onondaga Pottery Company and a few other far-seeing companies in the purchase prizes offered in connection with the National Ceramic Exhibition held annually in Syracuse.

Others perhaps will soon be led to do likewise.

The whole matter then levigates to this, namely, that students of design are to be the necessary arbiters and "standard setters" of future public taste, dedicated to the task of producing sound and worthy design, and it rests with them to develop and produce ware of such quality that the public will no longer crave that which is "imported" or "novel." Manufacturers also will no longer be satisfied with the endless reproduction of the rococco, and the dealer and salesman will no more lament the necessity of supplying that which is so obviously meretricious.

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PROBLEMS OF DESIGNING FOR INDUSTRY*

By Edward W. Enthof

Abstract

The problems discussed are (1) the newness of the profession; (2) stagnation or the unwillingness to depart from traditional design or obsolete production methods; (3) attitude of those responsible for new product production in trying to match similar products of rival manufacturers; (4) lack of a proper appreciative training on the part of those responsible for the production and sales of a product; and (5) lack of cultural education on the part of the public.

This subject is often discussed among designers and commercial artists, working along similar lines. In trying to analyze the difficulties and problems of this more or less new profession, many times the discussions will lead to names and personalities of those who control their output. The remarks may be complimentary or uncomplimentary, and many of the "big" problems encountered at the time often resolve themselves into petty details as time moves on.

How well the writer recalls his first "problem" as an industrial or product designer. He had accepted a position with a progressive organization which was increasing its staff of designers at the time. This organization had found that from a sales and manufacturing standpoint it was profitable to restyle its merchandise and so had proceeded to build a design and development department of its own, hiring some people with good design background and others trained along mechanical lines. The setup, one of the first of its kind outside of the automotive industry, was rather ideal. Aesthetic designers worked alongside mechanical designers, one group working in conjunction with the other to produce an article artistically and mechanically well designed to fit a set price range. The artists were presided over by a chief designer and the mechanical men by an engineer. The two groups were controlled by a merchandise development manager, a man who could readily grasp the essence of sketches and mechanical drawings, who knew something of materials, manufacturing processes and costs, and who demanded the utmost.

That "problem" was not one of mechanics or procedure or of selling some one on a particular design or idea. It was rather primarily one of personality. Criticism or comments were not left to the chief designer but were often made over the shoulder of the designer by the manager, in a not too complimentary way, accompanied at times by threats of dismissal. The designs, at the time, often were only in a preliminary state when no one should have seen them. The effect was to create a psychological strain that was not conducive to good design. This situation has since been remedied.

The manufacturers also obviously have their difficulties after hiring a designer.

The industrial or product designer is comparatively new. He must be ready to work in any medium, conforming his design to the limitations imposed by price and production methods. It is architecture of the everyday useful object. Design is not just surface decoration. A famous artist cannot be hired to make a few drawings or paintings of flowers and landscapes to be applied, for example, to a piece of pottery ware. Fundamentally, this is not good design. The piece first must be structurally and functionally correct, combined with a pleasing shape. If this is well done there is hardly need for surface decoration. Every one interested should see and read the comparison between a well-designed cup and saucer and one poorly designed as described by Forsyth.[1]

The designer, in working, is dependent upon the engineer, the mechanical designer, and the salesman.

Design of a product heretofore in the industrial or manufacturing field has been controlled by precedent, and the "dressing up" of the piece was left to one of the draftsmen or craftsmen, whom someone had previously discovered to have an artistic urge. The design, partly under way, was then subjected to any changes insisted upon by the heads of the different departments involved and it "just grew." This policy is still apt to show its influence even after the services of a designer are bought. Owing to the newness of the profession and the complexity of most manufacturing organizations, it may require a little time for the proper adjustment to be made and the designer's work to be used to best advantage.

Designers have worked and are working still as separate organizations, but the tendency more recently has been for the larger and more progressive manufacturers to establish their own design departments. Each system has its advantages and disadvantages. The outside created designs are apt to be freer, whereas work created in the organization is more likely to be in sympathy with the production methods of that organization.

Much good creative work is prevented from seeing the light of day because of an unwillingness in many cases to depart from traditional design or obsolete production methods. An article may sell fairly well, and yet the design can be improved without a great deal of expenditure. Should changes then be made at the risk of not having the customer buy it because he is not accustomed to it or does not recognize it? The designer, of course, knows the answer. Changes must

* Presented at the Forty-First Annual Meeting, American Ceramic Society Chicago, Ill., April 18, 1939 (Art Division). Received April 18, 1939.

[1] Gordon Forsyth, Twentieth Century Ceramics, pp. 9–11. The Studio Publications, Inc., 381 Fourth Ave., New York, N. Y., 1938.

not be too radical, but with restyling, the chances are that the sales will increase. Again, a suggestion is made by the designer to change the shape or section of an article to a rectangular one from the present and past tendency to make it round. He knows that similar changes have been made by other manufacturers who have found it more adaptable to modern design and cheaper to manufacture. Yet he receives the answer that the change is impractical because it will increase tool costs, finishing costs, etc. The answer to this probably will lie in the investigation of present production or manufacturing methods.

There is also the tendency among many companies to try to match similar products put out by rival manufacturers. The sales force must have something that will compare closely with a rival product so that when the rival product is specified by a customer, their own will compare closely enough to be acceptable. In some industries, it is necessary for some standardization of products, dimensions, and certain other specifications. It is not necessary, however, that this standardization should be carried out also with the exterior styling.

Design approval in an organization should not rest with some one whose only basis of judgment is a comparison with the similar product of a rival.

Thus it may be that the lack of proper appreciative training on the part of those responsible for the production and sale of a product may create just as much of a problem for the designer as the lack of cultural education on the part of many of the public who are expected to choose and buy the better designed article.

Crane Company
Chicago, Illinois

WORK OF PROFESSIONAL AND SERVICE DIVISION, WORKS PROGRESS ADMINISTRATION, IN CERAMICS*

By Whitney Atchley

I. Introduction

Programs of the Works Progress Administration are initiated and operated in response to community needs and demands. Plans for projects are developed in the states in accordance with the skills and aptitudes of the unemployed and to meet local needs. Every project must have an official sponsor, that is, a public agency with the necessary legal authority to engage in the work anticipated. In other words, the WPA attempts to assist existing institutions in executing and extending their programs. The sponsor provides all or a large part of supervision, space, materials, and equipment. In a majority of cases, this contribution amounts to all but about 2% of nonlabor costs for the project. It may be seen that projects, both in plan and operation, are a direct outgrowth of community needs.

II. Types of Ceramic Activities

Works Progress Administration ceramic activities are of three types. (1) Training projects, in which only the teacher or leader is a certified relief worker paid from Federal funds—the participants are nonrelief people who enjoy the opportunity of learning and practicing the craft of ceramics for avocational reasons. The participant furnishes his own materials, and the articles made for his own pleasure and use remain his property.

(2) The production projects include pottery made by crafts projects as well as sculpture and tile by the Federal Art Project. Resulting products are the property of the Government and are used for exhibitions and placed in public buildings.

(3) The research projects are sponsored and supervised by existing state-supported schools and research institutions. The results of such programs are published and are available for public distribution.

III. Community Needs Determine Projects

It is interesting to examine some of the community needs, other than re-employment, from which these projects spring. The need for training projects is indicated by the growing public demand for participation in cultural activities. This is the result of a normal impulse for creative expression which is not satisfied by "manufactured" art, either domestic or imported. It is significant to note that WPA in many cases has tried to discourage craft activities, but persistent demands from the states attest to a widespread desire for expression through the crafts.

(1) Clay Resources

Pottery is a good medium for such expression because it provides experience for people with an impulse toward scientific as well as artistic expression. In addition, the presence of usable pottery clays in practically every part of the country eliminates high material costs. A survey of craft projects in all states made in September, 1938, showed only one where no clay of any value for recreational pottery work could be found. Thirty-eight states reported fair to good clay resources.

(2) Low-Cost Equipment

A problem not so easily solved, however, is that of equipment for the recreational or educational group. Ceramic equipment is expensive, and the available small-scale equipment is often incapable of turning out quality work. The Technical Services Laboratory, a service agency for craft projects with which the writer is connected, has been developing designs to meet this problem, and with the assistance of several schools

* Presented at the Forty-First Annual Meeting, American Ceramic Society, Chicago, Ill., April 18, 1939 (Art Division). Received May 26, 1939.

and other laboratories, several low-cost kilns and other simple items of pottery equipment have been worked out. These are now being used with considerable success.

(3) Ceramics in Recreation Programs

Ceramic work as part of the recreation program is operating in all except twelve states. There has been some interesting work in Georgia, for example, based on excavations of Indian pottery made on an archeological project near Savannah. The results, in terms of recreational values, have been so encouraging that local recreation agencies, schools, and the Park Service in several parts of the State are furnishing equipment and a staff to carry on recreational ceramic activities as a permanent part of their local recreation programs, independent of the WPA.

(4) Useful Product Demands

Although the production projects are fewer in number, they are a result of growing cultural needs in America and the recognition accorded American art in the past few years. The participants in these projects are certified for relief and are paid from Federal funds. Some of them are trained artists, designers, and technicians; others possess various aptitudes which may be converted into useful skills.

Useful products are made by these projects for institutions supported by public funds, such as schools and hospitals where no funds are available on their regular budgets for such items. Institutions which need and request products furnish the materials; the sponsor (often a state university or a state board of education) provides space and equipment. In this way, not only are people employed and skills developed but designers and craftsmen are faced with problems of a contemporary nature. The solving of such problems provides a type of practical training which, unfortunately, is not often available at our art and ceramic schools.

IV. Creative Ceramic Craftsmen

Practical, contemporary limitations are of utmost importance to the designer and craftsman, for wherever strong design and craft movements are found, a good share of their vitality may be traced to the fact that leaders have faced the problems at hand instead of casting nostalgic eyes on the glories of the past or of relying on the sentimental appeal of "handmade" articles.

The creative ceramic craftsman, functioning effectively in his particular environment, can produce designs for products which point the way for larger scale production. This is not merely wishful thinking but has actually occurred in ceramics and in other fields in several European countries, most notably in Sweden. The writer does not suggest that the United States should follow blindly the example of other countries, but inspiration may be drawn from the way Swedish craftsmen have adapted folk art forms and patterns to contemporary use. This has produced a sound type of design thoroughly modern in feeling, yet with a distinct and desirable national character. Such developments, of course, require time, but if the efforts of more of our studio potters can be directed to a study of contemporary needs and how these may be met by our rich supply of design material, both traditional and modern, and by our abundant supply of raw materials, progress in American ceramic design will be greatly accelerated.

(1) Research Projects

In several research units in ceramics the work already completed is not important solely to the states in which it is being conducted but promises to have national value. A research project, which has been operating for some time under the direction of G. H. Brown of Rutgers University, is an excellent example of this type of activity. Thorough tests on undeveloped deposits of New Jersey shales and clays are being made. Experimental production with these clays includes not only excellent structural clay products, viz., floor tile, wall tile, and decorative tile, but clays have been discovered which make excellent decorative ware.

Another project located at the University of Mississippi, under the direction of W. C. Morse, has made discoveries which have attracted the interest of the ceramic industry. This project is developing many clays suitable for brick and stoneware and, in addition, has discovered sizable deposits of kaolin and ball clays.

Other projects of this type are located at the University of North Dakota and the University of Missouri.

An interesting development is the tendency to draw creative designers and craftsmen into the work of the research projects. This coördination of the design and technical phases of ceramics is to the benefit of both technician and artist. It provides the creative designer with a background of sound technical research for his work, and it adds a fourth and important phase of testing (design and product development) to the study of natural resources. It is important that this type of coöperation should be encouraged in every possible way.

Many outstanding examples of WPA ceramic work could be mentioned which have met with favorable and enthusiastic comment from ceramic experts, artists, and critics.

(2) Ceramic Sculpture

Ceramic sculpture made for Roosevelt Park, New Brunswick, N. J., is bold and original and suggests possibilities for new and interesting uses of ceramic sculpture in connection with architecture. The use of architectural ceramics flourished some ten or fifteen years ago, but its use died out, partly because of the lack of new ideas and designs. Vital new designs for architectural ceramics can come only from the creative ceramist working in close harmony with the architect and the technician. Progressive architects have shown a great deal of interest in the work of WPA artists and technicians in this medium. There is no material for decorative architectural use that can compete with ceramics either in variety of color and texture or in cost.

An interesting exhibition of architectural ceramics made for public buildings in Illinois was held in the

spring of 1939 at the WPA Federal Art Project of Chicago, 433 East Erie Street.

Projects in Ohio, North Dakota, California, Missouri, and other states have produced outstanding work in tile and pottery as well as sculpture.

V. Civic Organizations Coöperate

More interesting than the critical acceptance of WPA ceramic work, however, is the response such work has had on the part of civic organizations. In Coral Gables, Fla., for example, a small activity was started and supervised by a talented ceramic worker who found that local clays, not used before, were suitable for making decorative tile. The local school board became interested and sponsored the production of a large series of tile to be used in connection with the new Coralway School. After this work was completed, the planners of the new City Hall at Miami requested a larger job for their building. This project has produced valuable work for the community and, in addition, has trained a number of people in useful skills; but, more important, the city of Coral Gables has become interested to the extent of providing two acres of ground and space as an encouragement to what promises to become a small independent industry.

VI. Conclusions

The benefits of WPA participation in ceramic activities are apparent even from this brief description of the program. Some of them are long-range, but many are immediate, and all are significant to this group.

The highlights of these benefits are the opportunities offered by production projects to train people in design and craftsmanship and also to provide valuable permanent works of art and useful articles for publicly supported agencies. Such training and such products fill a definite need.

The research projects increase possibilities for future employment by the development of natural resources.

The most important benefit, however, is the opportunity offered both by production and recreational-educational projects for large groups of people to participate in ceramic work on a voluntary basis. As industry becomes larger, it must depend more and more upon increased consumer taste, resulting in a demand for quality products on the part of an increasingly larger number of people. Manufacturers recognize the need for consumer education. Everyone agrees that it is important and also that the job is large and difficult. The making of pottery, even on an amateur scale, is one of the most effective means to increase interest in pottery. Higher taste levels mean a higher level of consumer demand, more jobs for designers and craftsmen, and increased production for industry.

The rapidly growing interest in American art and the utilization of natural resources should be a decided impetus to the development of our ceramic art. Diminishing sources of European ceramics are also favorable to such a development. There is no lack of creative energy or ability in this country. Craftsmen, of course, need to be trained and artists must become acquainted with technical limitations of ceramics, but the modern artist, for the most part, welcomes such opportunities. He is quick to respond to the challenge of working with all types of materials.

The contemporary ceramic craftsman, in addition to studying materials, techniques, traditional designs, and contemporary needs, must study the problem of intelligent use of aids to hand production in order to survive. Because the strictly "handmade" article has little virtue aside from sentimental considerations, craftsmen should use handwork only where it counts most. Tools and machines should be understood and used wherever possible and whenever available. In modern craftwork, the thought and taste which go into shaping an article to fit its intended use are far more important than the fact that it is "handmade."

The writer has attempted to outline not only the type of work being done on WPA ceramic projects, but the direction in which the directors want it to move and the benefits they hope will result. The policies in this regard coincide rather closely with those expressed by Frederick H. Rhead, in a report made some time ago to the Art Division of The American Ceramic Society, with reference to the program of the Research Division. Mr. Rhead said: "One condition that is clear in my mind is the fact that the outlook or vision of the Art Division group should be in three directions: (1) educational; (2) it should function in the interest of the craft workers and studio potters; and (3) it should function in the interest of the mass production factories."

The WPA program in ceramics grows directly out of community needs, and for this reason, it must be kept flexible and open to new ideas. The program would benefit materially by the coöperation and thinking of the Art Division of The American Ceramic Society.

Assistant Director of Crafts, WPA Art Program
Works Projects Administration
Washington, D. C.

Author Note

Since this paper was written, certain changes have been made in the WPA.

Under the President's Reorganization Plan No. 1, effective July 1, 1939, the Works Progress Administration was renamed the Work Projects Administration and made part of the new Federal Works Agency.

In the 1939 Emergency Relief Appropriation Act, adopted by Congress, June 30, 1939, it was provided that the Federal Arts Projects—art, music, writers—must have local sponsors in the future. Under the new act, after January 1, 1940, not less than one fourth of the total costs of all non-Federal projects must be borne by the local sponsors.

NATIONAL YOUTH ADMINISTRATION IN CERAMIC ART*

By Vera Odeyne Neff

Abstract

The purposes of the National Youth Administration ceramic art project in Cleveland, Ohio, are described. A brief history of the project is given together with suggestions for further development.

I. Introduction

The purpose of this paper is to describe the Cleveland National Youth Administration Ceramic Art Project as well as to present the inherent possibilities and responsibilities of a program of increasing scope. The interest of the writer started professionally as a ceramic artist and later developed to the point of assuming the responsibility for the creation and development of a ceramic art project. There is a wide range of possibilities inherent in such projects for the youth employed and for the communities they serve.

Some of the background of experience and thinking of the writer is necessary if the aims of the NYA Project are to be understood.[1]

During 1925 and 1926, the writer studied for nine months at the Kunstgewerbeschule in Vienna, Austria; the remaining three months were spent in travel in Germany, Denmark, Norway, Sweden, France, and Czechoslovakia. The Kunstgewerbeschule was a technical art school with Micheal Powolny in charge of the ceramic art department; the enrollment of students was international with all European countries represented. This school provided equipment and space for the use of independent artists who were unable financially to provide themselves with a studio.

Cizek's famous school in Vienna, which offered children and adults an opportunity for study and creative expression in art, also attempted to discover, encourage, and help those with special talent, and a special emphasis was placed on ceramics. This program had some similarity to American settlement house work in its recognition of the recreational or avocational values in these types of art classes.

Throughout the stay in Vienna and during travels in other countries, the emphasis upon ceramic art was noted, both pottery and ceramic sculpture, as it was being taught in elementary and art schools. The Kunstgewerbe Museum in Dresden, for instance, had forty thousand ceramic pieces on display.

Not the least interesting of these visits was the time spent in chinaware and color manufacturing plants. An increasing awareness of the importance of the ceramic engineer and the ceramic artist was developed—not one ceramic engineer or artist, but groups of them, each devoting his special skill to the perfection of the product as a whole.

Art in Europe seemed to be an essential part of the life of the individual from the young child to the aged—from the peasant to royalty. They seemed to live and breathe to the rhythm of art.

II. European Versus American Art

Upon returning to America, the writer was more ceramic-minded—perhaps more art-minded. This new awareness may have emphasized the differences here. Museums in America devoted less proportional space to ceramics than those in Europe. Art schools, on the whole, had small ceramic departments. Art instruction in elementary and high schools was chiefly devoted to drawing.

As for the manufacture of dinnerware, only a brief survey over the past fifteen years is necessary to recognize what strides have been made in this area. The ceramic engineering and artistic staffs have been newly established or increased. The least art-minded housewife, visiting a dinnerware department of one of the retail stores today, is aware of the change in the shapes, colors, or designs of ware rather than the name on the back of the plate. Art has definitely invaded the manufacturing realm, and the utilitarian aspects have been delegated to their specific functions.

III. Recreational Artwork in America

Settlement houses, in the past, emphasized camp craft, nature lore, and had some classes in painting, sketching, dramatics, and music. Their programs are set up primarily for recreational purposes. The group activities are necessarily more informal than classroom instruction in schools. Group participation is primarily for the development of individual personality, and the social angle of recreation takes precedence over the development of specific skills. In recreational centers, however, the craft programs have placed little emphasis on ceramics. Two outstanding exceptions are Hull House in Chicago and Greenwich House in New York, and there may be a few more.

In the schools of social work in America, where group workers receive their training for settlement-house leadership, some craft classes are offered for understanding and appreciation, but ceramics is the least emphasized of these crafts.

Current with these changes, the manner in which art has invaded other fields should be considered. Household articles, i.e., kitchen furniture and utensils and laundry equipment along with parlor furniture are receiving the concentrated attention and effort of the artist. A comparison of the advertising pages of a magazine published in 1925 with those of 1939 will reveal the artistic progress in America during these fifteen years.

* Presented at the Forty-First Annual Meeting, American Ceramic Society, Chicago, Ill., April 18, 1939 (Art Division). Received May 9, 1939.

[1] The writer is no longer a member of the NYA organization and views this project in retrospect.

IV. Ceramic Art in Cleveland

A survey of this situation in 1936 showed that the Cleveland Art School had enlarged its Ceramic Art Department considerably in fifteen years of work. Students, in 1925, were working seriously on the handpainting of china; today there is a large ceramic department, and a number of graduates go to Vienna for specialized work in ceramics.

In the Cleveland artist's exhibit in the Cleveland Museum of Art fifteen years ago, known as the "May Show," there were only a few ceramic exhibitors, and the exhibits were placed in one room with other art exhibits. The exhibitions in ceramics now have one of the largest groups of exhibitors in the show and share space in four large rooms. It is interesting to note that although ceramics has such a prominent place in this show except in one or two instances no ceramists are acting as judges. If ceramic art is to be recognized as demonstrating special skills, it would seem reasonable to have a ceramist chosen to act on the jury which is composed of three judges.

(1) Recreational Ceramic Work

In the Cleveland municipal recreational centers and settlement houses in 1936, there was practically a complete absence of a ceramic program. A survey revealed an interest and a desire for such a program, but the lack of finances for equipment and instructors was the deterrent.

The problem of the ceramic art student who is finishing his training is different from that of most other artists. If he wishes to follow ceramics independently, he is met with frustrations unknown to other artists. He needs special equipment. Unless he has the financial means to equip a studio or has access to the equipment of a manufacturer, he is blocked in his attempts to use his specialized training to earn his livelihood or to make his creative contribution. This need of the ceramic artist has been of primary interest to the writer, who has constantly sought ways and means to develop resources within the community to counteract this situation.

Another interest of the writer in Cleveland has been the development of opportunities for children and adults to find an opportunity to express their interest and to develop their abilities in crafts, especially in ceramics. The most obvious opportunity for this was through the recreational centers and the Community Fund conducted settlements.

Possibilities for developing a ceramic program in settlements, with community interest and backing, also seemed to offer an indirect solution to the ceramic artist's problem. A stimulated community interest might be crystallized to the extent of providing necessary equipment for recreational centers and for offering to the artist a solution to his problem of studio and equipment. If the directors of settlements could be brought to recognize the values inherent in a ceramic art program, positions for ceramic artists in settlements would follow.

(2) Federal Aid for Cleveland

A possible source of help for Cleveland in 1936 was sought through Federal Aid. The persons who were offered this problem held positions that were related to such a program through their interest in art, recreation, business, and civic development, and they agreed that such a program would fill a real community need. One difficulty that was anticipated was that the project might not have an opportunity to function sufficiently long to demonstrate its real value. The program was new and would have to be "sold" to the community. There was also some uncertainty as to the length of time the Federal grants might be forthcoming for such projects. Difficulties were also pointed out related to the problems of sponsors and those in administrative positions with the Federal Government. These seemed to center around the fact that many of the most worthwhile values of such a ceramic teaching program were intangibles. The idea of such a project was primarily to offer both children and adults an opportunity to attend ceramic art classes for recreation with the additional opening to the gifted person to develop his talents.

V. National Youth Administration Art Project

The National Youth Administration was chosen not only because of the writer's interest in young people but also on the assumption that if a young person has average intelligence, a moderate interest in art, and an interest in such a program his own enthusiasm and flexibility of mind would be fertile soil for assuming at once the rôle of student and instructor.

The National Youth Administration Ceramic Art Project, with the city of Cleveland as sponsors, became a reality in February, 1936, and housing quarters were provided in the basement of the Broadway Recreation Center. Because funds were not available to purchase prepared clay, the WPA road projects were checked. A good clay bed was found and seventy-two tons of clay were delivered to various centers and playgrounds.

Simple animals were made of balls or coils of clay. Masques were modeled and one-piece molds were made. Beads, boxes, small bowls, vases, and ashtrays were other articles that were made in the beginning. When the molds were dry, cast and pressed pieces of ware were made.

Arrangements were made with the Cleveland Pottery Company to put through the first biscuit firing, and during the work of the project, Louis Friedl, president of the Cleveland Pottery Company, gave his encouragement and practical assistance.

The workers were taught some of the fundamentals of glaze preparation, and several glazes were compounded. These were applied by pouring, by painting, and by air-spraying.

From 1937 to August, 1938, the project, a two-fold program through natural development was followed, viz., the teaching program and production. The workers who remained on the program for a year or more began to produce some excellent work in pottery and the sculpturing of larger animals. Vases, ashtrays, and bowls were made. Animals and human figures were modeled. Some demonstration tile were also made, and large plaques were modeled for use in outdoor shelter houses and for some of the Cleveland

recreational centers. These were made in color. Smaller plaques were made, portraying athletic and dramatic figures in recreational center activities.

VI. Conclusion

An eagerness of the workers to follow their interest in ceramics was manifested in several ways. Some stayed overtime or made arrangements to come in to spend extra time to make articles for their own homes; some have sought further instruction at the Cleveland Art School and Polytechnic Institute. Several who have private employment are continuing their studies at Cleveland College. A number of the colored youth are on NYA projects which permit them to attend Wilberforce College.

Cleveland is becoming ceramic-art conscious. The Cleveland Art School, with its ever-increasing emphasis on ceramics, is graduating more ceramic artists. The instructors are providing leadership in this field. The Cleveland Museum has demonstrated its interest by providing additional space for ceramic art exhibits, and the recreational centers are placing greater emphasis on ceramics. The city of Cleveland, with its plans for an art recreational center and workshop, is definitely pioneering.

The Cleveland public school ceramic art program is developing an understanding and appreciation of ceramic art in the children. The NYA and WPA projects in ceramic art have made their contribution. There is a recognition of the use of this craft as a means of therapy in one of the state hospitals. Not the least of these influences is the contribution being made by the Ohio manufacturers and the Ohio State University, which is felt in Cleveland.

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INVENTORY-TAKING OF STRUCTURAL CLAY PRODUCTS RESEARCH PROGRAMS*

By Harry C. Plummer and Frederick Heath, Jr.†

Introduction

Assuming that an inventory would be helpful to research workers in structural clay products, the following discussion brings out, for tabulation, research work recently completed, under way, or planned, as follows:

(I) By Manufacturers
- (1) National
- (2) Regional
- (3) Companies

(II) By Institutions
- (1) National
- (2) Regional
- (3) Universities
- (4) and (5) Testing laboratories, private inventors, etc.

I. Manufacturers

(1) National

Mortars: A study on mortars, particularly the use of lime in mortars, is being sponsored by the National Lime Association at the Massachusetts Institute of Technology and is being carried out by Professor Voss.

Paving Brick: A research fellowship of the National Paving Brick Manufacturers Association has been established at the Ohio State University Engineering Experiment Station to study (1) laminations from different forming methods, thermal expansion, cooling, and the glass bond; (2) methods of tests and their correlation with the service behavior of the product; (3) paving-brick fillers and observation of several years by checking road surfaces; and (4) brick pavement design, monolithic brick, and particularly reinforced all-brick pavements.

Glazed Structural Tile: Another program at the Ohio State University Engineering Experiment Station, sponsored by the Glazed Brick and Tile Institute, is planned to study the fire resistance of glazed tile partitions and other glazed tile wall construction. Resistance apparently varies with the unit design and the raw material of the bodies, fineness of grinding, and firing.

Reinforced Brick: The Reinforced Brick Masonry Research Board that was organized some years ago under the auspices of the Brick Manufacturers Association of America still has funds. The Board hopes to resume at an early date some of the research programs at different places, primarily at engineering colleges.

(2) Regional

New York: The Brick Manufacturers Association of New York is carrying forward investigations with two research fellowships in coöperation with the New York State College of Ceramics at Alfred, N. Y. It is surveying the physical properties of the product now being made and is investigating ways of altering the properties.

New England: The Colonial Clays, Inc., a sales agency of some New England brick manufacturers, is surveying kiln samples of brick for physical properties. Research on efflorescence of brickwork has been started.

North Carolina: The North Carolina Engineering Experiment Station, in coöperation with the sales agency of that territory, Virginia-Carolina Clays, Inc., is doing research on tile floor slabs, determining the loading factors and design data.

Iowa: The Structural Clay Products Institute, Region 1-W, with headquarters in Iowa, is contemplating a program of glaze and engobe studies at the Iowa State Department of Ceramics. It plans glaze studies of member bodies with engobes made from clays from each of the others. Suitable glazes of other materials will be developed and applied to these bodies. Other phases of the program include vapor treatments, rendering clay impurities harmless, and kiln heat distribution. It is hoped that colors will be developed that are associated with sulfur, so that the sulfur present in Iowa coal may be utilized. A minimum of three years will be required for the program.

(3) Companies

There are two sources of activity on acoustical tile. H. R. Straight, of the Straight Engineering Co., Adel, Iowa, has a product reported to absorb approximately 25%, and the Stark Brick Company has developed a unit with sound absorption of about 22%. This is sketchy information and not to be considered scientific. It is merely reporting the activity.

There is private research being conducted at the Ohio State University Experiment Station by the Stark Brick Company and the Metropolitan Paving Brick Company. The research is understood to be on glazed ware.

II. Institutions

(1) National

Modular Service: There is an organization in Boston known as the Modular Service Association, which is doing analysis and detail work in coöperation with a new Sectional Committee A-62 of the American Standards Association. The sectional committee is sponsored by the American Institute of Architects and the Producers' Council. It held its first meeting in July, 1939, and it is hoped that a program may be worked out for coördinating the dimensions of all stock materials used in construction.

National Bureau of Standards: It is hoped that S.C.P.I. can inaugurate a fellowship at the Bureau of Standards to bring up to date physical test data on the properties of products made by its members. The work will be done at the Bureau of Standards and will be similar to the test program carried out in 1931 by the Brick Manufacturers Association and the Willingness-to-Certify program sponsored by the government.

A study on the moisture penetration of masonry has been completed recently at the Bureau of Standards and has been published in BMS-7. The work is being continued by checking the aging of the specimens already tested.

The Bureau is also checking fire resistance of tile partitions, a program of 30 walls, 6, 4, and 3 inches thick.

Work is also being done on freezing and thawing of brick, using the specimens that were collected in the 1930 Willingness-to-Certify program. This is for comparison with saturation coefficients (C/B ratio) and for checking the requirements of tentative A.S.T.M. specifications for brick.

In the recent $200,000 program on materials and methods for low-cost housing at the Bureau, structural tests of wall specimens were made, including strength testing of walls and floor constructions. In the clay products field, walls, some reinforced and some cavity, with both brick and tile and with brick alone, were also tested. Compression load, diagonal load, and other tests may be compared with tests on some of the new materials that have been developed.

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* Presented at the Forty-First Annual Meeting, American Ceramic Society, Chicago, Ill., April 19, 1939 (Structural Clay Products Division). Received June 9, 1939; revised copy received September 11, 1939.

† Director of Engineering and Research, Structural Clay Products Inst., 1427 Eye St., N. W., Washington, D. C.; and Secretary-Engineer, Colonial Clays, Inc., 311 Main St., Worcester, Mass., respectively.

(2) Regional

California: In California, the Clay Products Institute, coöperating with the California Institute of Technology on reinforced brick masonry, is surveying methods of testing. It has completed some pull-out tests of rods, has investigated the sway of vertical rods which occurs sometimes in the field, and has checked the properties of products and wall specimens for design data.

Iowa: The Agricultural Engineering Department of Iowa State College has completed a test program on vapor penetration through masonry walls.

(3) Universities

New Hampshire: Bond tests on second-hand brick vs. new brick were completed recently at the University of New Hampshire Experiment Station.

The University of New Hampshire Engineering Experiment Station has done some work on different types of lubricants for making waterstruck brick. Plain water is not used; tannic acid and other electrolytes are added. The effectiveness has been checked and some new media have been found.

Rhode Island: Two students are working on a thesis problem at Rhode Island State College, checking methods of conducting chemical tests for soluble salts in masonry materials and trying to find some short cuts so that a field test might be developed. H. G. Schurecht, incidentally, has been invited to send some of his standard wicks to the College so that the students may try them.

Wisconsin: G. J. Barker is continuing his work on pH control and soda ash at the University of Wisconsin.

Ohio State: There is a student thesis at Ohio State University on bond in reinforced brick masonry.

Rensselaer: At Rensselaer Polytechnic Institute, the Civil Engineering Department is testing different types of capping materials for brick and tile specimens in cooperation with A.S.T.M. Committee C-15.

Rutgers: The Rutgers University Department of Ceramics is coöperating with A.S.T.M. Committee C-15 on testing glazed brick and tile products.

Columbia: A program at Columbia University was recently completed in coöperation with A.S.T.M. Committee C-15 on the height-thickness relationship of masonry specimens.

(4) Testing Laboratories

A letter was addressed to 47 laboratories indexed under ceramics, brick, or tile in Bulletin No. 102 of the National Research Council list of "Industrial Research Laboratories of the United States." Replies have been received from thirty-six of these laboratories. Thirteen of the laboratories are not doing ceramic research at the present time, or their research is not related to the structural clay products branch of the industry. A summary of information contained in letters from twenty-three of these laboratories follows.

Battelle: Battelle Memorial Institute, Columbus, Ohio. Engaged in all phases of ceramic research. In the structural clay products field, work has been done on sand-cement brick, on salt-glazed and ceramic-glazed brick and tile, and on reinforced structural units and metal-faced units, including copper covered with a clear vitreous enamel that gives a permanent finish but retains the color and beauty of copper.

Mellon: Mellon Institute of Industrial Research, Pittsburgh, Pa. No research in progress at the present time relating to structural clay products. A Multiple Industrial Fellowship on Refractories has been established at the Institute.

Orton: The Edward Orton, Jr., Ceramic Foundation, Columbus, Ohio. Research at the Foundation is limited to the manufacture and control of pyrometric cones. The Foundation supports research at four schools which maintain departments of ceramics, viz., University of Illinois, Ohio State University, Rutgers University, and Pennsylvania State College.

(5) Testing Laboratories and Materials Suppliers

Mississippi Testing Laboratories, Jackson, Miss. Routine testing and inspection of brick, building tile, and clay pipe.

The James H. Herron Co., Cleveland, Ohio. No research in ceramics, clay, or tile at the present time; routine work in the analysis of clays and testing of brick and tile.

Robert W. Hunt Company, Engineers, Chicago, Ill. Testing work, according to recognized standards and procedures, on brick and tile. From time to time, research programs in ceramics of various sorts have been carried out, but there is none under way at the present time.

T. Poole Maynard, Atlanta, Ga. Research in the development of roofing granules and ceramic vitrified products. Specializes in processes of refining for the preparation of raw materials and for determining application of these raw materials into new manufactured products.

Ritter Products Corporation, Rochester, N. Y. A large electrostatic research laboratory maintained to investigate the separating and refining problems of many groups of minerals (not applicable to clay finer than 200-mesh).

Research Products Corporation, Madison, Wis. Development work on new processes for fabricating clay products of its own manufacture.

Continental Industrial Engineers, Inc., Chicago, Ill. Research on the formation of a fireproof wallboard from a plastic ceramic base. Continuous accelerated drying for ceramic products and a rapid firing, continuous enameling method are being studied.

E. I. du Pont de Nemours & Co., Wilmington, Del. The R. & H. Chemicals Department conducts investigations on the application of color to tile. The Grasselli Chemicals Department does research work on a service basis on the prevention of efflorescence in brick.

Barium Reduction Corporation, South Charleston, W. Va. Research covering the use of (1) precipitated barium carbonate for prevention of scum on brick, tile, and other fired ceramic ware and (2) barium stearate to prevent efflorescence on mortar and unfired blocks and other shapes.

The Vitro Manufacturing Co., Pittsburgh, Pa. Development of stains or colors of specialized types for customers.

The Titanium Alloy Manufacturing Co., Niagara Falls, N. Y. Improvement of zirconium and titanium products; determining their properties and usefulness in the ceramic industry (primarily in connection with glazes, bodies, enamels, and glass research).

The Harshaw Chemical Company, Cleveland, Ohio. This ceramic laboratory is available to customers for experimental work on problems related to the use of colors in their products. Research is being carried out on new ceramic colors and opacifiers with the aid of a recording spectrophotometer.

C. K. Williams & Co., Easton, Pa. A limited research program on various types of mineral body colors for structural clay products is done at the Ceramic Institute, Rutgers University. Particular interest in color effects of compounds of iron, manganese, chromium, and zinc in clay bodies.

Foote Mineral Company, Philadelphia, Pa. Current research work includes manganese flashing of red brick, new colorants for sand-molded brick, and new colorants for the body of the brick.

The O. Hommel Co., Pittsburgh, Pa. Research on coloring and glazing of structural clay products, including body stains, engobes, glazes, and glaze stains.

General Finishes, Inc., St. Paul, Minn. Research on its products used for waterproofing, which includes a product for repair or weatherproofing stucco, cement, or pointing of brickwork and two types of surface waterproofing.

Kobbe Laboratories, Inc., New York, N. Y. Principal research is with sulfur, including industrial cements for laying up acidproof brick.

The Atlas Mineral Products Co., Mertztown, Pa. Research on acidproof bonding materials for ceramic products.

ACTIVITIES OF THE SOCIETY

FORTY-SECOND ANNUAL MEETING, APRIL 7–13, 1940

CANADIAN OFFICIALS SAY "PACK YOUR BAGS"

Department of External Affairs
Ottawa, Ontario, Canada
November 17, 1939

Gordon C. Keith, Secretary,
The Canadian Ceramic Society,
Toronto 10, Canada

With further reference to your letter of the 3rd November, 1939, I have received a report from the Canadian Minister in the United States.

An amendment to the legislation was inserted by the House of Representatives, and accepted by the Senate, to take care of the anomalous situation which would be created if title to all travelers' luggage and supplies had to pass to a foreign state.

May I refer you to the provisions of Section 2 (*f*)(2), which provide that the title-transfer provision shall not apply "to any other transportation on or over lands bordering on the United States of any articles or materials" other than arms, ammunition, and implements of war.

It, therefore, seems to be clear that you will be able to hold your Meeting in Toronto next April without embarrassment. You have referred to Mr. Crearer's remarks in a letter to you, and there can be no doubt that every effort is being made, in both countries, to insure that the ordinary friendly intercourse will be undisturbed by the state of war.

—O. D. SKELTON,
Under-Secretary of State for External Affairs

SELLING CORPORATION MEMBERSHIPS

One of the Membership Committee men came to me last Saturday and, as a "hard-boiled, show-me-values" business executive, demanded to know what he would get out of an investment of $25.00 in The American Ceramic Society. Here is the answer to such a challenge.

(1) If the three monthly publications (the *Journal*, the *Ceramic Abstracts*, and *The Bulletin*) were all that a ceramic corporation received, it would be agreed that the returns on this investment would not be adequate in spite of the fact that some of the researches reported have cost corporations many dollars and have saved many dollars for other corporations. The Society is not issuing these three monthly journals for financial profit, and it is not primarily in the publishing business. The value from these publications cannot be stated in monetary terms.

(2) The three monthly publications of The Society are not in themselves the purpose of The Society's activities; they are its working tools. The prime purpose of The American Ceramic Society is to promote ceramic arts, science, and technology. It is for this purpose that meetings are held, committees are working, and publications are issued. No privately owned organization could thus serve the technical interests of ceramic corporations.

(3) What has The American Ceramic Society accomplished?

(*a*) By meetings and publications, this Society has encouraged the establishment of courses of ceramic instruction and laboratories of ceramic research in several universities, thus making trained men and information more generally available.

(*b*) Ceramic research now constitutes a large and increasing part of the activities of such institutes as Mellon, Battelle, Lewis, and Armour.

(*c*) The U. S. Bureau of Mines, several of the state geological surveys, and the state ceramic associations were promoted by The American Ceramic Society.

(*d*) The technical activities of ceramic trade associations are closely allied with, and in several instances result from, particular activities of this Society.

(*e*) The informational value of privately owned trade journals has risen during the past forty years as a direct result of activities of this Society.

(*f*) The several technical organizations, such as those primarily interested in physics, chemistry, geology, metallurgy, mineralogy, and mining have symposia in which this Society collaborates to engage the broadest possible thinking and study on ceramic problems.

(4) The American Ceramic Society is the only national organization devoted exclusively to the promotion of ceramic education and research.

(5) That there has been and now are values realized by ceramic corporations is evidenced by the fact that it has been supported by them for four decades and, at the present time, is being supported by 1825 Personal and 235 Corporation Members.

(6) The returns from an investment in The American Ceramic Society of a minimum of $25.00 annually are not to be seen in the form of books alone but are realized in technical information obtained from the several educational and research institutions, trade associations, and trade publications, and particularly from better-informed employees.

(7) A federation of persons and of firms with an organized program of educational activities does more than make known the results of research and plant experience; it brings persons together and thus builds productive and profitable comradeships that are worth more than publications.

—ROSS C. PURDY, *General Secretary*

P. S. Members joining in November and December will be considered as for the 1940 calendar. Each will receive the December issues, which carry the 1939 Indexes.

LOCAL SECTIONS

MICHIGAN-NORTHWESTERN OHIO SECTION

The first meeting of the 1939–1940 season was held in Detroit, October 13, with an informal dinner and evening of dancing for members and the ladies.

Despite the fact that it was Friday the thirteenth, thirty-seven persons were present and spent an enjoyable social evening of much merriment and singing, led by the inimitable maestro, Dick Lane.

—JOHN A. FOSTER, *Secretary*

SOUTHERN CALIFORNIA SECTION

The Southern California Section of The American Ceramic Society held its annual social party on October 28 at the Glendale Hotel, Glendale, Calif. Seventy members were present to partake of an old-fashioned Dutch lunch and beer, followed by a short entertainment. The remainder of the evening was spent in card games and singing.

—J. G. STEWART, *Secretary-Treasurer*

PITTSBURGH SECTION

The Pittsburgh Section held a meeting the evening of November 14, 1939. C. L. Van Derau, Plant Manager, Westinghouse Electric & Mfg. Co., Mansfield, Ohio, spoke on "Plant Production Problems."

There will be no meeting of this Section in December. Philip Dressler of the Swindell-Dressler Company will address the Section at the January meeting. His subject will be "Recent Developments in Design and Operation of Tunnel Kilns."

—C. L. THOMPSON, *Secretary*

SCHOOL NOTES

NEW YORK STATE COLLEGE OF CERAMICS STUDENT BRANCH

The New York State College of Ceramics Student Branch held its second and probably the outstanding meeting of the year on November 14. G. E. F. Lundell, Chief Chemist of the National Bureau of Standards, addressed the group. Dr. Lundell is in charge of the preparation and standardization of samples of standard material at the Bureau.

New York State College of Ceramics Student Branch Officers

Left to right: Stephen Day, *Vice-President;* Bernhard Gentsch, *Secretary;* Frank Arrance, *President;* and William Drohan, *Treasurer.*

Publication of *Alfred Engineer*

The student engineers of the New York State College of Ceramics and the one hundred visiting ceramists attending the Sixth Annual Meeting of the Ceramic Association of New York were pleasantly surprised when the officers of the Student Branch presented the first issue of the *Alfred Engineer.*

This four-page tabloid, edited by Ramond A. Zurer, '40, is the news organ of the Alfred Student Branch of The American Ceramic Society. The news of the Ceramic College, the Association Meeting, and the work of the New York State Ceramic Experiment Station were featured in this paper. The initial issue was highly commended by the visiting industrialists, and it is hoped that it will appear at least quarterly. Arrangements are under way for a second publication.

The Board of Editors includes Frank C. Arrance, Bernhard F. Gentsch, Stephen P. Day, and William C. Drohan, all seniors and officers of the Student Branch.

PENNSYLVANIA STATE COLLEGE

A. I. Andrews of the Ceramic Engineering Department of the University of Illinois and President of The American Ceramic Society addressed the members of the Penn State Student Branch at their meeting on November 14. His subject was "Factors Affecting Reflectance of Enamels," and his talk was illustrated by a number of excellent demonstrations.

—N. W. TAYLOR, *Head, Department of Ceramics*

UNIVERSITY OF WASHINGTON

Ceramic engineering students at the University of Washington have decided not to organize a complete Student Branch of The Society in deference to Dean Roberts of the Mines School. Dean Roberts feels that, owing to their small number, the group would do better to take active part in the A.I.M.E. student meetings. A secretary has been elected, however, to handle correspondence with The American Ceramic Society.

—PAUL MARMONT, *Secretary*

RUTGERS UNIVERSITY

The Rutgers Ceramics Club and Student Branch held its first open meeting the evening of November 13 in the Assembly Room of the Ceramics Building, Rutgers University, New Brunswick, N. J. The guest speaker was Fred A. Whitaker, General Ceramics Co., Keasbey, N. J., whose subject was "Manufacture and Uses of Chemical Stoneware."

Mr. Whitaker, who was born in England and educated in Germany, has been connected with the ceramic industries in this country for thirty years. His talk dealt with the various types of chemical stoneware in use today with respect to their resistance to chemical action, thermal conductivity, porosity, color, and conditions of use. He enumerated the materials entering into these types of chemical stoneware bodies and discussed the glazes used on them. He considered the different methods of forming the product, various problems encountered in these operations, the firing stage, and the grinding and finishing of the fired product. Many of his points were illustrated with models of some of the more unique products, and he supplemented the lecture with a colored motion picture film depicting the various operations involved in the manufacture of chemical stoneware in Plant 1 of the General Ceramics Company at Keasbey, N. J.

Music and refreshments followed Mr. Whitaker's lecture.

—GILBERT GOODMAN, *Corresponding Secretary*

STAHL BROTHERS GIVE POTTERY SHOW AT PENN STATE

Thomas Stahl, aged seventy-six, and his brother Isaac, aged sixty-seven, who operate the well-known Powder Valley Pottery near Bally, Lehigh County, Pa., gave an interesting demonstration with the potter's wheel on The Pennsylvania State College campus on Friday, November 10. The demonstration was sponsored by the Penn State Student Branch of The American Ceramic Society. Nearly 500 students, faculty, and townspeople attended the show and enthusiastically applauded whenever a jug or bowl or plate was deftly turned.

The Penn State show got under way in the hands of E. L. Hettinger of Reading, Pa., who has long been a booster for the old arts and crafts of eastern Pennsylvania and who acted as master of ceremonies for the evening. Guy Reinert of Boyertown, Pa., who is an expert on the Pennsylvania German potteries of the early nineteenth century, gave an interesting and informative talk on the European origin of some of the styles and designs which characterize the Powder Valley ware. Mr. Reinert also gave a history of the Stahl Pottery, which was established by Charles Ludwig Stahl in 1845 and continued in his charge until his death in 1896. The sons, Isaac and Thomas, continued the business until 1902, when all work was discontinued owing to the competition from machine-made pottery. With the revival of interest in the old handmade styles, Isaac and Thomas in 1932 decided to build a new kiln and to reopen the business which they had learned in their youth. Their present kiln has four fireholes in which they burn only wood as it is not possible to get satisfactory colors with coal firing

Not the least of the pleasures of the Stahl demonstration was the contagious enthusiasm the two brothers showed for everything connected with ceramics, which gave them an air of high-spirited youthfulness.

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THE INSTITUTE OF CERAMIC ENGINEERS

Executive Committee

President: J. L. CARRUTHERS, Ohio State Univ., Columbus, Ohio.
Vice-President: H. G. WOLFRAM, Porcelain Enamel & Mfg. Co., Baltimore, Md.
Secretary: S. J. McDOWELL, General Ceramics Co., Keasbey, N. J.
Past-President: A. F. GREAVES-WALKER, Univ. of North Carolina, Raleigh, N. C.
Trustee Representative: R. E. BIRCH, Harbison-Walker Refractories Co., Pittsburgh, Pa.

Ceramic Engineers Meet With A.I.M.E.

On invitation from the A.I.M.E., the Institute of Ceramic Engineers coöperated with the Industrial Minerals Division of that society in a meeting held at Tuscaloosa, Alabama, November 2 to 4. T. N. McVay and B. C. Burgess served as chairmen of the Ceramic and Refractory Materials Session, at which the following papers were presented.

(1) "Kaolin and Mica Fines," by James A. Barr, Jr., Kaolin, Inc.
(2) "Bentonite," by Paul Bechtner, President, American Colloid Co.
(3) "Ball Clay in Western Tennessee," by R. B. Carothers, General Manager, H. C. Spinks Clay Co.
(4) "Processing and Refractory Properties of Southern Clays," by W. H. Vaughan, Director, State Engineering Expt. Station, Georgia School of Technology.

When the Industrial Minerals Division of the A.I.M.E. meets, nothing less than a complete listing of the papers would include all those of interest to ceramic engineers. The following list, however, includes a few additional papers of most interest: "Kyanite in the Piedmont Province of Alabama," by Edgar Bowles, Assistant State Geologist, Alabama Geological Survey; "New Discovery of Bentonite in Southern Alabama," by Edgar Bowles; and "Flotation of Diatomites," by Oliver C. Ralston and J. E. Norman, U. S. Bureau of Mines.

Institute Items

Christian W. Planje, of Gladding, McBean, & Co., Lincoln, Calif., was appointed to represent the Institute at the annual meeting of the National Council of State Boards of Engineering Examiners held in San Francisco.

Last year the Committee on Ceramic Engineering Education sent a questionnaire to the employers of recent ceramic graduates to determine the employer's slant on the adequacy of ceramic education. Anyone can devise a questionnaire, but considerable expertness is required to boil down the results into such an interesting and enlightening report as the one which resulted from this study (see *The Bulletin*, p. 248, September, 1939).

The committee chairman, E. H. Fritz, reports that another phase of the investigation is under way. This time the searching eye is directed toward the ceramic engineer himself. He is being asked to answer questions concerning ceramic education acquired both in and out of school.

No previous announcement has been made of the personnel of the Committee on Professional Status and Development. The complete committee follows: *Chairman*, John W. Whittemore, Virginia Polytechnic Institute, Blacksburg, Va.; Richard S. Bradley, A. P. Green Fire Brick Co., Mexico, Mo.; and Arthur T. Malm, Norton Company, Worcester, Mass.

OUR DETERMINATION TO MAKE UP $7500 WAR LOSS

(See the November *Bulletin*, 1939, p. 437)

NEW MEMBERS FOR NOVEMBER

Corporation

INDUSTRIAL CERAMIC PRODUCTS, INC., W. E. Cramer (voter), 965 W. Fifth Ave., Columbus, Ohio.

Personal

ANTAKI, EMILE, Calle España 402–600, Avellaneda, Buenos Aires, Argentina, South America; chemist, Ferrum Industria Argentina de Metales S. A.

BAKER, ROBERT J., 827 Ferndale Ave., Dayton, Ohio; process foreman, Frigidaire Div., General Motors Co.

BOOTH, SEAVER H., 40 Franklin St., Ansonia, Conn.; general foreman, Casting Dept., American Brass Co.

BRUSH, GEORGE D., 965 W. Fifth Ave., Columbus, Ohio; vice-president, Harrop Ceramic Service Co.

BUZARD, FRED T., Bell St., Plymouth, Ohio; vice-president, Fate-Root-Heath Co.

CARTER, C. E., 203 Callender Ave., Peoria, Ill.; president, Peoria Brick & Tile Co.

CORBAN, WILBUR H., 3042 Midgard Rd., Columbus, Ohio; field geologist, Magnolia Petroleum Co.

CRANDALL, EUGENE R., 46 W. Main St., Milford, Conn.; research engineer, Mullite Refractories Co.

DAVIS, HENRY M., Mineral Industries Bldg., State College, Pa.; assistant professor of ceramics, Pennsylvania State College.

DAVIS, ROBERT F., 630 Beechwood Ave., Carnegie, Pa.; salesman, O. Hommel Co.

DEEGAN, JOSEPH E., 24 South 4th St., Steelton, Pa.; ceramic engineer, Bethlehem Steel Co.

HALL, DOUGLAS (student), Box 273, Flossmoor, Ill.; teacher, Flossmoor School.

HARNER, LEO E., R. R. No. 1, Aurora Station, Ohio; enamel service.

IRELAND, JOHN, International Tin Research & Development Council, Fraser Road, Greenford, Middlesex, England; director of development.

JACKSON, JAMES, Ashgrove, Bothwell, Lanarkshire, Scotland; chemist and director, Jackson, Elphick & Co., Ltd.

*LONGENECKER, H. L., Seaboard Refractories Co., Perth Amboy, N. J.

LYTLE, W. ORLAND, 2000 Grant Bldg., Pittsburgh, Pa.; secretary, Pittsburgh Plate Glass Co.

PRIOR, HAROLD D., 1310 Vanderbilt Ave., Niagara Falls, N. Y.; ceramic engineer, Titanium Alloy Mfg. Co.

ROSENBERG, YETTA, 2233 Westminster Rd., Cleveland, Ohio; teacher.

SCHELL, ALFRED O., Wayne Pump Co., Fort Wayne, Ind.; foreman, Sign and Enameling Dept.

SIROVY, GEORGE, 6643 S. Narragansett Ave., Chicago, Ill.; vice-president, Century Vitreous Enamel Co.

TROTT, R. P., General Abrasive Co., Inc., Niagara Falls, N. Y.

*WALL, GERTRUDE R., Grand Hotel, Wailuku, Maui, Hawaii; ceramic artist.

Student

University of Illinois: AXEL C. OTTOSON.
Iowa State College: W. J. HARR.
New York State College of Ceramics: WAYNE E. BROWNELL and B. F. GENTSCH.

* Indicates former member of The Society rejoining.

University of North Carolina: CLAUDE N. KIMBALL, JR.
Ohio State University: HOWARD J. ORLOWSKI.
Pennsylvania State College: PAUL M. CORBETT, JOSEPH D. D'AMICO, and WILLIAM H. ORTH.
University of Saskatchewan: FRANK H. MCRITCHIE.
University of Washington: JOHN W. BELL.

MEMBERSHIP WORKERS' RECORD

Corporation

A. S. Watts	1

Personal

A. I. Andrews	2	Wilfrid Mavor	2
M. G. Babcock	1	Vera O. Neff	1
E. C. Henry	1	E. P. Ogden	1
F. E. Hodek, Jr.	1	W. H. Pfeiffer	1
E. M. Hommel	1	Office	12

Student

A. I. Andrews	1	P. P. Turner	1
C. M. Dodd	1	W. G. Worcester	1
E. C. Henry	2	C. H. Zwermann	1
C. W. Parmelee	1	Office	3
		Grand Total	**35**

ROSTER CHANGES DURING NOVEMBER*

Corporation

ARMSTRONG CORK CO., E. Claxton (voter), Central Technical Lab., Lancaster, Pa. (Whitall-Tatum Co., Millville, N. J.)

Personal

BREWSTER, H. M., 1865 Grove St., Glenview, Ill. (Chicago, Ill.)
CAMP, R. ELDRIDGE, S.A.L. Ticket Office, Tallahassee, Fla. (Atlanta, Ga.)
CORDES, JOHN E., 3556 N. Teutonia St., Milwaukee, Wis. (Rockford, Ill.)
DENISON, W. C., JR., R. D. No. 1, Powell, Ohio (Columbus, Ohio)
DIPPELL, LAWRENCE V., 1109 Arrott St., Philadelphia, Pa. (Rochester, Pa.)
HILGENBERG, CARL R., Carr-Lowrey Glass Co., Box 356, Baltimore, Md. (New York, N. Y.)
KAUTZ, KARL, 11 Elm St., Burgettstown, Pa. (Langeloth, Pa.)
LECHNER, ERNEST A., Camark Pottery, Camden, Ark. (Wellsville, Ohio)
MARSHALL, ALBERT E., 730 Elmgrove Ave., Providence, R. I. (New York, N. Y.)
MCCANN, SIDNEY W., Pfaudler Co., Rochester, N. Y. (Schwetzingen, Baden, Germany)
MONCRIEFF, J. W., 311 Cobalen St., Crooksville, Ohio (Cleveland, Ohio)
MULLER, MAX M., 819 East St., Flint, Mich. (Columbus, Ohio)
PERRY, ROBERT, Victor Insulator Co., Victor, N. Y. (Medina, N. Y.)
POTTS, AMOS P., Straitsville Brick Co., New Straitsville, Ohio (Brazil, Ind.)
REINKER, GERALD E., Mahoning Glass Works, General Electric Co., 403 N. Main St., Niles, Ohio (Cleveland, Ohio)
TUTTLE, GEORGE N., Porcelain Enamel & Mfg. Co., Baltimore, Md. (Dayton, Ohio)
WILLIAMS, ROBERT B., Central Y.M.C.A., Chattanooga, Tenn. (Atlanta, Ga.)
ZINSZER, WILLIAM K., Des Plaines Pottery, Des Plaines, Ill. (Ames, Iowa)

* Address in parentheses is former address.

NECROLOGY

PAUL G. WILLETTS

Paul Gladstone Willetts died at his home in West Hartford, Conn., on October 7, 1939. He had been ill for several weeks with a sinus infection, and pneumonia finally developed from which he never recovered.

Mr. Willetts was born in Pittsburgh, Pa., February 6, 1882.

As a youth he worked for his father in the Willetts Clay Company in Pittsburgh, Pa., and later on joined the Willetts Company in Fairmont, W. Va.

At one time he managed the Camden Coal and Clay Company of Arkansas, and the French Clay Blending Co., of Lester, Arkansas, in both of which he owned a controlling interest. While operating these two firms he designed, developed, and manufactured complete equipment and machinery for blending clays.

Paul Gladstone Willetts

In 1924 Mr. Willetts became associated with the Hartford-Empire Company, in charge of refractories development. During the course of this association he obtained about 30 patents on processes and materials important in glass manufacture and furnace construction. In addition he had patented several inventions outside the ceramic field.

Although Mr. Willetts had been prominently associated with the ceramic industry for many years he had been a member of The Society only since 1926. He attended the Autumn Meeting of the Refractories Division at Conneaut Lake in September and apparently was in good health at that time.

Mr. Willetts had traveled extensively in America and abroad and had spent considerable time in Australia

studying the mineral deposits of that country and their utilization in the ceramic industry. His knowledge of clay and mineral deposits in the United States and many foreign countries was extensive.

The high esteem in which Mr. Willetts was held by his associates at the Hartford-Empire Co. was evidenced by their memorial to him at the Newington Home for Crippled Children, consisting of furnishing a library.

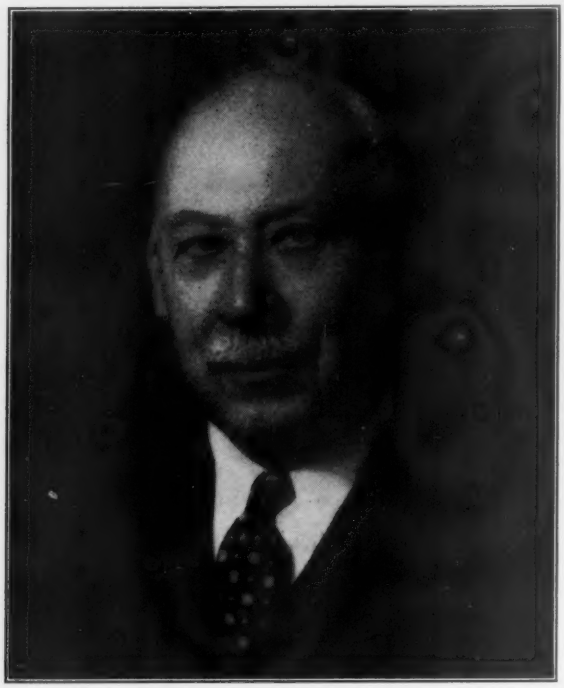
Mr. Willetts is survived by his widow, three sons, a daughter, and six grandchildren.

CHARLES F. CLIPPERT

Charles F. Clippert, brick manufacturer and prominent in public service, died in Detroit, Mich., October 31, 1939, after a brief illness. He was seventy years old.

Mr. Clippert was born in Detroit and attended the public schools. He was employed as engineer and foreman in his father's brickyard and later entered the firm. He became president of the Clippert Brick Company in 1899. He also served as president of the Builders and Traders Exchange.

He was a director of the Dunn Sulphite Paper Co. of Port Huron, the People's State Bank of Fordson, and the American Trust Co., of which he was elected chairman in 1920.



Charles F. Clippert

For many years, Mr. Clippert was an active member of the National Brick Manufacturers Association and of the Common Brick Manufacturers Association. His son, Conrad, is active in the Structural Clay Products Institute.

Mr. Clippert is survived by his wife, his son, and two daughters.

The following editorial is taken from the *Detroit Free Press:* "Charles F. Clippert was a citizen of the sort that help to give solidity and permanence to the communities in which they live.

"Born in Detroit, and a life-long resident of the city, Mr. Clippert for many decades was a factor in its business and industrial development, and he displayed an intelligent interest in its public affairs that all too few people manifest."

MATTHIAS F. CUNNINGHAM

Matthias F. Cunningham, treasurer and general manager of the Waltham Grinding Wheel Co., died suddenly Monday, November 6, at his home in Waltham, Mass. He was sixty-seven years old.

Mr. Cunningham was born in Waltham, where he was educated and always lived. He entered the employ of the Waltham Emery Wheel Company when he was a boy. Later he purchased the Superior Corundum Co., which he sold for cash to a combine. In 1921, he purchased controlling interest in the Waltham Grinding Wheel Co., and later he acquired all of the stock of this Company.

Matthias F. Cunningham

Mr. Cunningham was always energetic, sagacious, thrifty, and unselfish. He gave generously of his time, money, and abilities to political, civic, and social affairs, always with the purpose of bettering life for his community, his associates, and his employees. His intimate knowledge of and personal attentions to the welfare of the families of his employees and associates characterized his vision of good fellowship. He was popular not only in Waltham but with his grinding-wheel competitors and customers. He advanced himself, his business, and the welfare of his employees by his happy consideration of every one whom he met and with whom he did business.

Matthias F. Cunningham was distinguished for his large heart and his far vision.

He was a member of Waltham Council, Knights of Columbus; Waltham Lodge, B.P.O.E.; the Grinding Wheel Manufacturers' Association; and The American Ceramic Society, in which he had been a Corporation Voter for the Waltham Grinding Wheel Co., since 1924. He was also a trustee of the Waltham Savings Bank.

Surviving Mr. Cunningham are his widow and three daughters.

Funeral services were held in Waltham on November 10, including a solemn high mass of requiem in St. Mary's Church.

H. W. PETERS

H. W. Peters of Columbus, Ohio, was killed on September 22, 1939, when he was returning from Portsmouth, Ohio. Mr. Peters had been a member of The American Ceramic Society for a number of years.

FRANK E. TROUTMAN

Frank E. Troutman, President of the Clearview Glass Company, Butler, Pa., died suddenly of a heart attack on November 16, 1939. Mr. Troutman was born in Butler, Pa., March 4, 1885. He attended the Butler grade and high schools and was graduated from Mercersburg Academy in 1904. In 1908, he received the degree of Mechanical Engineer from Lehigh University. Mr. Troutman began work in 1908 under the supervision of his father in the plant of the Standard Plate Glass Company.

He went through every department of the glassmaking industry and by 1914 was fully equipped by experience and training to fill the office of plant superintendent. He occupied that position until his father's death in 1919, when he became president.

Following the sale of the Standard Plate Glass Company to the Franklin Glass Corporation, Mr. Troutman organized his own company with a plant at Renfrew, which was incorporated as the Clearview Glass Company.

During the course of an active business career, Mr. Troutman was a leader in several civic enterprises.

Mr. Troutman had been an active member of The American Ceramic Society since 1919.

NOTES AND NEWS

BATTELLE APPOINTS TECHNICAL ADVISER IN PHYSICAL CHEMISTRY

Edward Mack, Jr., former head of the Department of Chemistry at the University of North Carolina, has been added to the supervisory staff of Battelle Memorial Institute. The appointment of Dr. Mack has come as a result of increased activities in the application of physical chemistry to the Institute's varied research program. He will act as technical adviser in physical chemistry to the sponsored industrial projects and will also correlate the Institute's fundamental research work.

Edward Mack, Jr.

Dr. Mack was head of the Department of Chemistry of the University of North Carolina for the past four years. He is a graduate of Centre College and of Princeton University, receiving his Doctor's degree from the latter university in 1916. He later studied at Harvard, the Sorbonne, the University of Chicago, and the University of Munich. He became an instructor in chemistry at the University of West Virginia in 1917, subsequently entering the Chemical Warfare Service, in which he held the rank of major.

He was appointed assistant professor of the Chemistry Department of Ohio State University in 1917, and from 1925 to 1935 he was professor of physical chemistry. In 1935, he went to the University of North Carolina as head of the Department of Chemistry.

Dr. Mack's accomplishments in physical chemistry have received wide recognition. He has made many notable contributions in the field of molecular structure, diffusion, X-ray crystallography, and physicochemical processes, and he has had an extensive and varied experience as an industrial consultant. He was a member of the National Research Council from 1928 to 1933 and of the Westinghouse Advisory Board in 1930 and 1931. He is a Fellow of the American Physical Society and a member of the American Chemical Society.

He is co-author of a standard text on physical chemistry and an associate editor of the *Journal of the American Chemical Society*.

ARMOUR AND LEWIS INSTITUTES TO FORM ILLINOIS INSTITUTE OF TECHNOLOGY

James D. Cunningham, Chairman of the Board of Trustees of Armour Institute of Technology, and Alexander D. Bailey, Chairman of the Board of Lewis Institute, have announced that their respective institutions have entered into an agreement to consolidate into a great technological center for Chicago. This is the first occasion on which two colleges of engineering have ever agreed to merge their interests to produce an institution of more important scope.

The name of the new school is to be Illinois Institute of Technology, with the background and reputation of the two component colleges recognized by maintaining their names as applied to its two divisions.

The actual consolidation of the educational program will be complete by September, 1940, and the remainder of 1939 will be given over to planning an integration of activities. For the time being, it will be necessary to operate both the Armour and Lewis plants, but the complete development of the new center of technology contemplates the acquisition of a new, well-planned campus, conveniently located, to meet the needs of its broad objectives.

The budget of the Illinois Institute of Technology contemplates an annual expenditure of one and one-quarter

million dollars for education and research services to the community. It is, therefore, evident that through this combination, Chicago will be provided with a program of technological education of a scope and quality not previously available in this area.

PORCELAIN ENAMEL INSTITUTE, INC.

Ninth Annual Meeting

The Ninth Annual Meeting of the Porcelain Enamel Institute, Inc., was held at the Hotel Pennsylvania, New York, N. Y., November 16 and 17, 1939.

The following papers were presented:

(1) "Ten Points for a Successful Association Campaign,' by C. B. Larrabee, Managing Editor, *Printers' Ink*.

(2) "The Consumer Wants to Know," by L. E. Williams, Advertising Manager, *Retailing*.

(3) "Steel Producer's Viewpoint on Porcelain Enamel," by L. A. Estes, Manager, Commerical Division, Carnegie-Illinois Steel Corp.

(4) "Railroad Experience with Enamelware," by A. L. Green, Freight Claim Division, Association of American Railroads.

(5) "What the Homemaker Wants in Appliances," by G. W. Alder, Consulting Engineer, Good Housekeeping Institute.

(6) "How Building Codes Affect Use of Porcelain Enamel," by B. L. Wood, Consulting Engineer, American Iron and Steel Institute.

(7) "Porcelain Enamel Institute in 1940," by F. E. Hodek, Jr., President, Porcelain Enamel Institute.

(8) "Labor Relations," by Ralph A. Lind, Consultant, Stevenson, Jordon, and Harrison.

(9) "Apprentice Training," by A. W. Grimme, Manager, Industrial Relations, Paulsboro Refinery-Socony Vacuum Oil Co.

(10) "Color on Household Appliances," by Howard Ketcham, Color and Design Engineering.

(11) "Design of Household Appliances," by Charles H. Oppenheimer, President, Designers for Industry, Inc.

The officers of the Porcelain Enamel Institute for 1938–1939 are F. E. Hodek, Jr., *President;* H. V. Mercer, *Vice-President;* William Hogenson, *Treasurer;* and C. S. Pearce, *Secretary*.

OHIO CERAMIC INDUSTRIES ASSOCIATION

The officers of the Ohio Ceramic Industries Association for 1939–1940 are *President*, C. Forrest Tefft, Claycraft Co., Columbus, Ohio; *Vice-President*, George W. Denison, Ohio Clay Co., Cleveland, Ohio; *Treasurer*, Robert K. Beck, Metropolitan Paving Brick Co., Canton, Ohio; and *Secretary*, H. E. Nold, Lord Hall, Ohio State University, Columbus, Ohio. The members of the Board of Trustees are J. Leo Child, Hancock Brick & Tile Co.; C. S. Finzer, Finzer Brothers Clay Co.; E. E. Hillyer, Clay City Pipe Co.; E. E. Davis, Davis Fire Brick Co.; Harry Callahan, U. S. Quarry Tile Co.; W. Keith McAfee, Universal Sanitary Mfg. Co.; W. H. Locke Anderson, Edwin M. Knowles China Co.; B. T. Bonnot, Bonnot Co.; and F. R. Henry, Simonds Worden White Co.

CERAMIC ASSOCIATION OF NEW YORK ANNUAL MEETING

The Sixth Annual Meeting of the Ceramic Association of New York was held at the New York State College of Ceramics in Alfred, October 20. The meeting was the largest and most successful to be held. Nearly one hundred executives and leaders of the ceramic field and many students and faculty members attended.

O. I. Chorman, vice-president in charge of research at the Pfaudler Co., president of the Association, was the presiding officer.

Twelve reports on the research work covered by the members of the New York State Ceramic Experiment Station were presented.

The officers elected for 1939–1940 are *President*, Edward Schramm, Onondaga Pottery Co.; *Vice-President*, J. C. McNeely, Sutton and Suderly Brick Co.; and *Secretary and Treasurer*, M. E. Holmes. G. S. Diamond, Electro Refractories Co., and Lawrence E. Barringer, General Electric Co., were elected to the Board of Directors.

The women were entertained with an interesting program of pottery throwing and a liquid air demonstration.

CENTRAL DISTRICT ENAMELERS' CLUB

The first meeting of the Central District Enamelers' Club for the 1939–1940 season was held Friday, December 1, at the Hotel Carter, Cleveland, Ohio. The following program was presented: (1) "Matching of Synthetic Whites in Porcelain Enamel," by Fred H. Emery, Harshaw Chemical Co., Cleveland, Ohio. This subject was of interest to all who are confronted with matching synthetic whites.

(2) "Observations of the Service Man." The second subject on the program was covered by men representing five frit companies, who discussed incidents in which better control and practice would have avoided enameling troubles.

Officers of the Central District Enamelers' Club are *President*, R. H. Schwendler, Enamel Products Co.; *Vice-Presidents:* A. L. Leeseberg, American Stove Co.; R. S. Cobb, Moore Enameling & Mfg. Co.; J. B. Simons, Westinghouse Electric & Mfg. Co.; G. B. Fulton, Alliance Porcelain Products Co.; and W. J. Leighner, Strong Mfg. Co.; *Secretary-Treasurer*, G. E. Pfleger, Harshaw Chemical Co.

NATIONAL PAVING BRICK ASSOCIATION ANNUAL MEETING

The Thirty-Fourth Annual Meeting of the National Paving Brick Association will be held in Chicago, Illinois, January 30 and 31, 1940, at the Congress Hotel. In addition to the business meetings on the first day, the sessions on January 31 will be open to the general public. The meeting is scheduled during the week of the 1940 Road Show-Convention of the American Road Builders' Association, and the "road builders" who will be in the city are invited to attend the open sessions.

The program will include papers and discussions by prominent engineers and contractors experienced in the use of brick for paving purposes. Important recent developments in manufacturing, in the technique of testing, and in construction practices will be presented. Experience with additional mileage of the vibrated monolithic brick pavement, an outstanding development in paving design including laboratory investigations of its structural strength, will be covered. The Research Bureau of the Association, located at the Ohio State University Experiment Station, will make its annual report, containing a summary of the principal research projects. These include several coöperative studies with the U. S. Public Roads Administration and state highway departments.

The unique salvage value and durability of brick in the modernization and reconstruction of pavements will be described by engineers in actual charge of such programs. The adaptability of brick as a heavy-duty type to highways that are important in national defense will be a particular theme of this convention.

C. C. Blair, Metropolitan Paving Brick Company, Canton, Ohio, is President, and George F. Schlesinger is Chief Engineer and Secretary of this Association.

UNITED STATES POTTERS ASSOCIATION ANNUAL MEETING

The United States Potters Association will hold its Sixty-First Annual Meeting at the Mayflower Hotel, Washington, D. C., January 23 and 24, 1940.

CORPORATION MEMBERSHIPS ARE PROFITABLE INVESTMENTS

UNITING TO ACHIEVE

- For **41 years** Personal Members of The American Ceramic Society have been exchanging technical information and have been promoting educational and research agencies to the limit of their financial abilities.
- The reason that for over **4 decades** they have rendered personal service and the reason they are paying **$12.50** annually are the values they obtain when they come together, work together, and record their findings.
- During 1939, Personal Members published **128 research reports** and **5201 abstracts** of the world-wide ceramic literature. They have done this for the industrial welfare of the ceramic corporations by whom they are employed.
- **128 research reports** for $25.00 or **5 research reports** for $1.00 or 20 cents each.
- **5201 abstracts** for $25.00 or **208 abstracts** for $1.00 or about 0.5 cent each.
- Personal Members **can** increase their coöperative production if more ceramic corporations **will** give financial support.

It Is Only by Communication with Others That Knowledge Is Aquired

PAID MEMBERSHIP RECORD

Date of Record	Members Paid		Deferred	Subscriptions	Monthly Sales	Total Circulation
	Personal	Corporation				
December 10, 1936	1452	196				
December 22, 1937	1713	220	12	523	220	2688
December 19, 1938	1815	222	26	589	220	2872
November 18, 1939	1850	236	30	641	220	2977

CERAMIC HISTORY

GUSTAV HOTTINGER*

Gustav Hottinger was born in Vienna, Austria, March 24, 1848, of Swiss parentage. His education was secured in Vienna, where he received degrees as an artist and sculptor. When he was nineteen years old, he left Vienna and came to the United States, going directly to the home of an uncle in Centralia, Ill.

He went to Chicago in 1879 where he secured employment with The Chicago Terra Cotta Company, which was located at Fifteenth and Laflin streets on the west side. He stayed with this company until it failed.

He worked in a number of ceramic plants in Ohio for about a year and then returned to Chicago.

In 1873, together with a number of former employees of The Chicago Terra Cotta Company, he formed a partnership, known as True, Brunkhorst & Company—The Northwestern Terra Cotta Works. Although there were a number of partners in this firm, all but four dropped out. These four were John R. True, John Brunkhorst, Henry Rohkam, and Gustav Hottinger. Mr. True, who originally came from Maine, served as bookkeeper and accountant; Mr. Brunkhorst and Mr. Rohkam were experienced potters from Germany; and Mr. Hottinger performed the art work and, until 1895, was in charge of all experiments and developments.

The first plant in which the company operated was a small two-story building located on the north side of Chicago at Wells Street and Lincoln Avenue, directly across from Lincoln Park. The products manufactured here were flowerpots, garden vases and furniture, and small statuary.

When the manufacture of architectural terra cotta was added to the production, the plant was found to be too small, and the company rented and moved to the plant of the old Chicago Terra Cotta Company. Production was now concentrated on structural terra cotta. The company was incorporated as The Northwestern Terra Cotta Company in 1878. In the year 1881, Fritz Wagner, Sr., joined the company in charge of sales and promotion.

As the demand for terra cotta grew, the plant, which had only two kilns, was again found to be too small. A site was purchased in 1882, a new plant was built, and four 16-foot kilns were installed. These kilns are on the present site of the company plant at Wrightwood and Paulina streets in Chicago.

Mr. Hottinger laid out the plans for the new building, installed all the equipment, and from that time he supervised all plant additions and designed all the kilns and special machinery used in the plant.

The advent of the skyscraper in Chicago led to the growth and expansion of the company until it became the largest company in this country to manufacture terra cotta exclusively.

Mr. Hottinger died July 27, 1929.

The following notice is reprinted from *The Bulletin*, **7** [3] 70 (1928).

Industrial Art School in Chicago

The recent announcement made by the Association of Arts and Industries of the $50,000 contribution of Gustav Hottinger, President of The Northwestern Terra Cotta Company, to the fund for establishing an Industrial Art School was greeted with enthusiasm by the public-spirited citizens of the Middle West. Mr. Hottinger's generous donation completed the quota of $260,000 set by the Rockefeller Foundation as the condition for an additional gift of $100,000.

The Industrial Art School to be housed in the Art Institute of Chicago is now assured. It will offer the finest instruction in all industrial arts, including architectural modeling, jewelry, printing, wall paper, textiles, ceramics, interior decorating, and costume designing. "The Hottinger Foundation of Architectural Modeling, Founded by Gustav Hottinger, 1928," will take care of that department.

Mr. Hottinger's gift was not primarily for the purpose of establishing a fitting memorial for his name but of giving ambitious young men an opportunity to train themselves properly for better service in the industrial field. Now the president of the largest terra cotta company in the United States, Mr. Hottinger began as a clay modeler with only his ambition and natural talents to aid him. He realizes perhaps more than others the potentialities for good the new school possesses.

This is not his first act of outstanding philanthropy. Several years ago he gained nation-wide attention by his gift of a $4,000,000 share in The Northwestern Terra Cotta Company to the thirty-six men who had helped him build up his great business.

Mr. Hottinger has supported The American Ceramic Society from the time of its inception, has recognized the value of employing scientists and engineers especially trained in ceramics, and has been in the lead in the employment of artists to create and extend the use of terra cotta. The terra-cotta industry is greatly indebted to him, but no more so than all the varied ceramic industries. The founding of an Industrial Art School is only another of Mr. Hottinger's contributions to industrial ceramics.

* See also *The Bulletin*, **8** [9] 324 (1929).

For a Continuing Education in Ceramics
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of

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A Monthly Publication Devoted to Proceedings of The Society, Discussions of Plant Problems, Discussions of Technical, Scientific, and Art Questions, and Promotion of Coöperative Research

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Kentucky Clay Mining Co.
Maxson, Elwyn L.
Paper Makers Importing Co.
Potters Supply Co.
Spinks, H. C., Clay Co.
The Vitro Mfg. Co.
United Clay Mines Corp.

Clay (Bentonite)
American Colloid Co.
Edgar Plastic Kaolin Co.
Great Lakes Foundry Sand Co.

Clay (Block)
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.

Clay (China)
Ceramic Color & Chemical Mfg. Co.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Maxson, Elwyn L.
Paper Makers Importing Co.
The Vitro Mfg. Co.
United Clay Mines Corp.

Clay—Cleaners, Feeders
Lancaster Iron Works, Inc.

Clay (Electrical, Porcelain)
Ceramic Color & Chemical Mfg. Co.
Edgar Plastic Kaolin Co.
Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.
Kentucky Clay Mining Co.
Maxson, Elwyn L.
Paper Makers Importing Co.
Spinks, H. C., Clay Co.
United Clay Mines Corp.

Clay (Enamel)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Kentucky Clay Mining Co.
Maxson, Elwyn L.
Metal & Thermit Corp.
Paper Makers Importing Co.
Porcelain Enamel and Mfg. Co.
Spinks, H. C., Clay Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.
United Clay Mines Corp.

Clay (Fire)
Denver Fire Clay Co.
Great Lakes Foundry Sand Co.
Maxson, Elwyn L.

Paper Makers Importing Co.
Potters Supply Co.
United Clay Mines Co.

Clay (German Vallendar)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Kentucky Clay Mining Co.
Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Clay (Micronized)
Porcelain Enamel and Mfg. Co.

Clay Miners
American Colloid Co.
Edgar Plastic Kaolin Co.
Great Lakes Foundry Sand Co.
Maxson, Elwyn L.
Paper Makers Importing Co.
Spinks, H. C., Clay Co.
United Clay Mines Corp.

Clay (Potters)
Denver Fire Clay Co.
Hammill & Gillespie, Inc.
The Hommel Co., O., Inc.
Kentucky Clay Mining Co.
Maxson, Elwyn L.
Paper Makers Importing Co.
Spinks, H. C., Clay Co.
United Clay Mines Corp.

Clay (Process Equipment)
Lancaster Iron Works, Inc.
National Engineering Co.

Clay (Sagger)
Edgar Plastic Kaolin Co.
Great Lakes Foundry Sand Co.
The Hommel Co., O., Inc.
Kentucky Clay Mining Co.
Maxson, Elwyn L.
Paper Makers Importing Co.
Potters Supply Co.
Spinks, H. C., Clay Co.
United Clay Mines Corp.

Clay-Slip (Albany)
Hammill & Gillespie, Inc.
United Clay Mines Corp.

Clay (Wad)
Kentucky Clay Mining Co.
Potters Supply Co.
Spinks, H. C., Clay Co.
United Clay Mines Corp.

Clay (Wall Tile)
Edgar Plastic Kaolin Co.
Hammill & Gillespie, Inc.
Kentucky Clay Mining Co.
Maxson, Elwyn L.
Paper Makers Importing Co.
Spinks, H. C., Clay Co.
United Clay Mines Corp.

Cleaners
Pennsylvania Salt Mfg. Co.
Porcelain Enamel and Mfg. Co.

Cleaners, Chemical
Harshaw Chemical Co.
Pennsylvania Salt Mfg. Co.

Clocks (Gauge Board)
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.

Cobalt Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Cobalt Sulphate
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Colors
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Concrete (Chutes, Grouters)
Ransome Concrete Machinery Co.

Cones
The Edward Orton, Jr., Ceramic Foundation

Conveying Equipment
Frazier-Simplex, Inc.
Lancaster Iron Works, Inc.
National Engineering Co.

Copper Oxide
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Corhart
Corhart Refractories Co.

Cornwall Stone (Imported)
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Maxson, Elwyn L.
Paper Makers Importing Co.

Crucibles (Filter, Melting, Ignition)
Carborundum Co.
Denver Fire Clay Co.
Norton Co.
Potters Supply Co.

Crushers (Clay)
Lancaster Iron Works, Inc.

Cryolite (see Kryolith)
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pennsylvania Salt Mfg. Co.
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Cullet, Washing Plants, Incinerators, Crushers
Frazier-Simplex, Inc.

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Ceramic Color & Chemical Mfg. Co.
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Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Disintegrators
Lancaster Iron Works, Inc.
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Lancaster Iron Works, Inc.
Proctor & Schwartz, Inc.

Electrocast Refractories
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Enamelers' Borax
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Enameling Equipment (Complete)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Frazier-Simplex, Inc.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
The Vitro Mfg. Co.

Enameling Furnaces
Carborundum Co.
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Lancaster Iron Works, Inc.
Norton Co.

Enameling Iron (Sheet)
American Rolling Mill Co.
Bethlehem Steel Co.

Enameling Muffles
Bethlehem Steel Co.
Carborundum Co. (*Carbofrax*)
Chicago Vitreous Enamel Product Co.
Frazier-Simplex, Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Norton Co. (*Alundum*)

Enameling (Practical Service)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Metal & Thermit Corp.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Enamels
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Porcelain Enamel and Mfg. Co.
The Vitro Mfg. Co.

Enamel Oxide
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.

Enamels (Porcelain)
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Equipment (Porcelain Enameling)
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The DeVilbiss Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.

Exhaust Systems
The DeVilbiss Co.

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Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Maxson, Elwyn L.
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Carborundum Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Norton Co.

Fire Brick—Process Equipment
Lancaster Iron Works, Inc.

Fire Clay
Denver Fire Clay Co.
Great Lakes Foundry Sand Co.
Spinks, H. C., Clay Co.

Flint
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Great Lakes Foundry Sand Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Maxson, Elwyn L.
Paper Makers Importing Co.
Porcelain Enamel and Mfg. Co.

Flint Pebbles
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
The Vitro Mfg. Co.

Floors (Non-Slip)
Norton Co.

Fluorspar
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The Hommel Co., O., Inc.

French Flint
Maxson, Elwyn L.
Paper Makers Importing Co.

Frit
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Chicago Vitreous Enamel Product Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana Inc.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

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Harshaw Chemical Co.
The Hommel Co., O., Inc.

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Frazier-Simplex, Inc.

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Carborundum Co. (*Carboradiant*)
Chicago Vitreous Enamel Product Co.
Denver Fire Clay Co.
Frazier-Simplex, Inc.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
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Furnaces, Enameling
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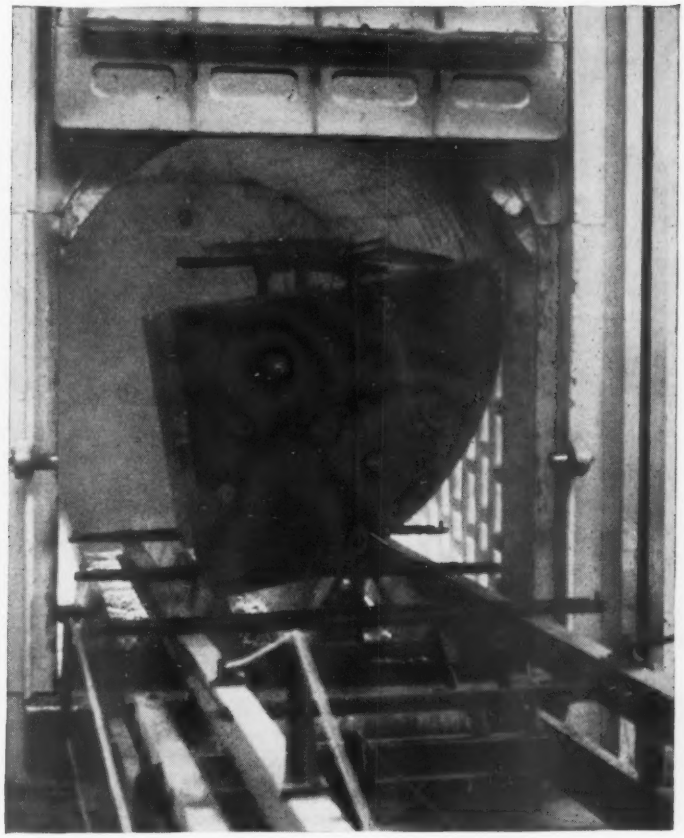

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Lithium Minerals
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Magnesia (Sintered, Calcined)
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The Hommel Co., O., Inc.
Porcelain Enamel and Mfg. Co.

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Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Magnesite Calcined
Foote Mineral Co.
The Hommel Co., O., Inc.

Magnesium Carbonate
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Manganese
Ceramic Color & Chemical Mfg. Co.
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Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

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Edgar Plastic Kaolin Co.
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Harshaw Chemical Co.
The Hommel Co., O., Inc.
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Nitre
Harshaw Chemical Co.
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Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

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Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.

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Chicago Vitreous Enamel Product Co.
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Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Metal & Thermit Corp.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

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The Hommel Co., O., Inc.

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The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Louthan Mfg. Co.
Potters Supply Co.

Pins (Tile Setter)
Louthan Mfg. Co.

Placers (Concrete Pneumatic)
Ransome Concrete Machinery Co.

Placing Sand
Great Lakes Foundry Sand Co.
United Clay Mines Co.

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The Hommel Co., O., Inc.

Polariscopes
Bausch & Lomb Optical Co.
Frazier-Simplex, Inc.

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Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Porcelain Enamels
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.

The Vitro Mfg. Co.

Potters Wheels
Denver Fire Clay Co.

Potash (Carbonate)
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Solvay Sales Corp.
The Vitro Mfg. Co.

Producer Glass Plants
Frazier-Simplex, Inc.

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Lancaster Iron Works, Inc.

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Foote Mineral Co.
The Hommel Co., O., Inc.

Pyrometer Tubes
Carborundum Co.
Montgomery Porcelain Products Co.

Pyrometer Tubes (Refractory and Hard Porcelain)
Denver Fire Clay Co.
McDanel Refractory Porcelain Co.
Montgomery Porcelain Products Co.
Norton Co.

Pyrometers (Optical, Radiation, Surface, Immersion, Needle)
Pyrometer Instrument Co.

Pyrometric Cones
The Edward Orton, Jr., Ceramic Foundation

Racks, Firing (Refractory)
Louthan Mfg. Co.

Raw Material Handling Equipment
Frazier-Simplex, Inc.
Lancaster Iron Works, Inc.

Refractometers
Bausch & Lomb Optical Co.

Refractories
Carborundum Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Louthan Mfg. Co.
Norton Co.

Refractory Materials
Carborundum Co.
Chicago Vitreous Enamel Product Co.
Corhart Refractories Co.
Denver Fire Clay Co.
Louthan Mfg. Co.
Norton Co.
Titanium Alloy & Mfg. Co.

Respirators
Chicago Vitreous Enamel Product Co.
The DeVilbiss Co.
Drakenfeld, B. F., & Co.
The Hommel Co., O., Inc.

Rutile
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Edgar Plastic Kaolin Co.
Foote Mineral Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Metal and Thermit Corp.
Titanium Alloy & Mfg Co.
The Vitro Mfg. Co.

Saggers
Carborundum Co
Norton Co.
Potters Supply Co.

Salt Cake
American Potash & Chemical Co.
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pennsylvania Salt Mfg. Co.

Sandblast Sand
Great Lakes Foundry Sand Co.

Sand Grinder and Sifters
Lancaster Iron Works, Inc.

Saponin
The Hommel Co., O., Inc.

Screening and Magnetic Separators
National Engineering Co.

Selenite of Sodium
Drakenfeld, B. F., & Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Selenium
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Setters (Tableware)
Louthan Mfg. Co.

Sheaves (Tower)
Ransome Concrete Machinery Co.

Sheets (Enameling Iron)
American Rolling Mill Co.
Bethlehem Steel Co.

Silica (Fused)
Edgar Plastic Kaolin Co.
The Hommel Co., O., Inc.

Silicate of Soda
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
Harshaw Chemical Co.
The Hommel Co , O., Inc.

Silicon Carbide
Carborundum Co.
Norton Co.

Silicon Carbide Firesand
Carborundum Co.

Sillimanite Refractories
Denver Fire Clay Co.

Slabs (Furnace)
Carborundum Co.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Norton Co.

Soda Ash
American Potash and Chemical Corp.
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pennsylvania Salt Mfg. Co.
Solvay Sales Corp.
The Vitro Mfg. Co.

Sodium Antimonate
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
The Vitro Mfg. Co.

Sodium Fluoride
Ceramic Color & Chemical Mfg. Co.
Denver Fire Clay Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Sodium Metasilicate
Harshaw Chemical Co.

Sodium Nitrite
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Sodium Silica Fluoride
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Sodium Uranate
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Soot Blowers
Frazier-Simplex, Inc.

Special Machines
Frazier-Simplex, Inc.

Spar
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Maxson, Elwyn L.
Paper Makers Importing Co.
The Vitro Mfg. Co.

Spray Booths
The DeVilbiss Co.
The Hommel Co., O., Inc.

Spraying Equipment
The DeVilbiss Co.
The Hommel Co., O., Inc.

Spurs
Louthan Mfg. Co.
Potters Supply Co.

Stacks
Lancaster Iron Works, Inc.

Steel Plate Construction
Bethlehem Steel Co.
Lancaster Iron Works, Inc.

Stilts
The Hommel Co., O., Inc.
Louthan Mfg. Co.
Potters Supply Co.

Sulfuric Acid
Denver Fire Clay Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Pennsylvania Salt Mfg. Co.

Talc
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.

Tanks
Frazier-Simplex, Inc.

Tank Blocks
Corhart Refractories Co.

Tanks (Pickle)
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.

Tanks for Raw Material Steel or Concrete
Bethlehem Steel Co.
Lancaster Iron Works, Inc.

Tile (Floor)
Norton Co.

Tile (Muffle)
Carborundum Co.
Norton Co.

Tile Setter Pins
Louthan Mfg. Co.

Tile (Refractory)
Carborundum Co. (*Carbofrax*)
Chicago Vitreous Enamel Product Co.
Denver Fire Clay Co.
Norton Co.

Tile (Wall)
Denver Fire Clay Co.

Tin Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
The Vitro Mfg. Co.

Titanium
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Titanium Oxide
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Towers (Concrete, Concrete Elevating, Steel Elevating)
Ransome Concrete Machinery Co.

Trisodium Phosphate
Harshaw Chemical Co.

Trucks
Lancaster Iron Works, Inc.

Tubes (Insulating)
Carborundum Co.
Louthan Mfg. Co.
McDanel Refractory Porcelain Co.
Norton Co.

Tubes (Pyrometer)
Carborundum Co.
Denver Fire Clay Co.
McDanel Refractory Porcelain Co.
Montgomery Porcelain Products Co.
Norton Co.

Uranium Oxide
Drakenfeld, B. F., & Co.
Harshaw Chemical Co.
The Hommel Co., O., Inc.

Uranium Oxide (Yellow-Orange-Black)
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Water Softening Plants
Frazier-Simplex, Inc.

Wet Enamel
Ceramic Color & Chemical Mfg. Co.
Chicago Vitreous Enamel Product Co.
The Hommel Co., O., Inc.
Ingram-Richardson Mfg. Co. of Indiana, Inc.
Porcelain Enamel and Mfg. Co.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Whiting
Ceramic Color & Chemical Mfg. Co.
Drakenfeld, B. F., & Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Hammill & Gillespie, Inc.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Paper Makers Importing Co.
The Vitro Mfg. Co.

Winding Drums
Lancaster Iron Works, Inc.

Zinc Oxide
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
The Vitro Mfg. Co.

Zircon
Edgar Plastic Kaolin Co.
Foote Mineral Co.
The Hommel Co., O., Inc.

Zirconia
Ceramic Color & Chemical Mfg. Co.
Du Pont de Nemours, E. I., & Co., Inc., R. & H. Chemicals Dept.
Harshaw Chemical Co.
The Hommel Co., O., Inc.
Metal & Thermit Corp.
Titanium Alloy & Mfg. Co.
The Vitro Mfg. Co.

Zirconium Oxide
Foote Mineral Co.
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Zirkite (Natural ZrO_2)
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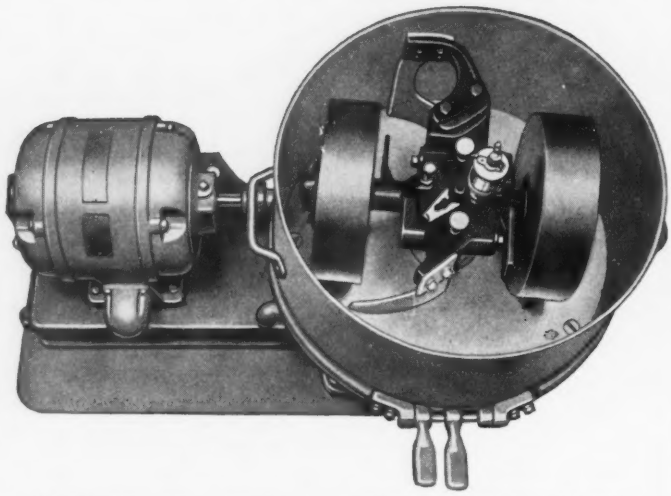

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December 1, 1939

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We still say "Yea Kentucky" and we still like Tennessee.

Now that the shoulder pads and the cleats are put away for the Winter—think it over. No matter how smart the Coach, he had to have good material. So must you, Pete, and we think the controlled high quality of **JERNIGAN** and **CHAMPION & CHALLENGER** Ball Clays are your best defense against losses and a real offense to score for you on the profit side. Always remember, they only pay off for profits in the potting game.

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Dick Carothers

General Manager
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